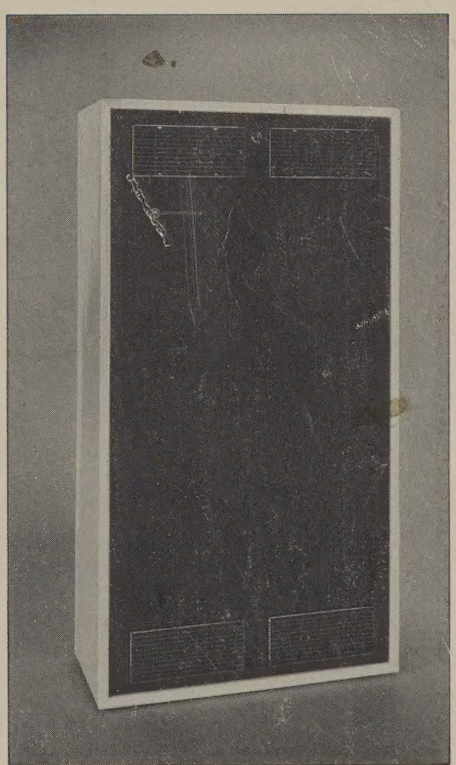
MOTOROLA

"MICOR"®

Base and Repeater Stations

406-420 MHz 12 W/45 W/75 W
450-470 MHz 12 W/20 W/45 W/75 W
470-512 MHz 12 W/20 W/40 W/60 W

68P81025E50-C



This Manual Must be Used With Control and Applications Manual 68P81025E60

AVAILABLE BACKGROUND REFERENCE PUBLICATIONS

Three reference publications are available to provide background information needed to service some of the newer Motorola products more effectively. The information in these publications is not duplicated in our instruction manuals. To obtain your free copy, check the ones you want and return this self–mailer to us. (NOTE: One copy of each publication has already been distributed to Motorola Service Shops (MSS's) and field technical representatives (FTR's).

First Fold

First Fold

Check item desired:

☐ **Basic Logic Circuit Guide** 68P81105E88

Describes the basic logic circuits used in Motorola Communications digital equip–ment and the logic notational scheme used in our instruction manuals.

☐ **"Digital Private–Line" Binary–Coded Squelch** 68P81106E83

Contains fundamentals of "Digital Private–Line" system operation, circuit operation and servicing techniques.

☐ **Safe Handling of CMOS Integrated Circuit Devices** 68P81106E84

Describes special handling techniques needed to prevent irrepairable damage from static charges encountered with normal handling of CMOS devices.

Second Fold

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To the User of this Manual:

Many servicemen have asked for smaller manuals with more servicing information on the schematic diagrams.

This manual uses a new approach which we feel fulfills this desire. The circuit descriptions and circuit maintenance data are now incorporated on the schematic diagram (or on a facing page).

First
Fold

This new approach makes the manual smaller as well as easier to use because it puts the information at the serviceman's fingertips.

We would appreciate hearing how you like the new approach after you have used the manual a few times. Please take a few minutes to give us your comments.

_____

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EPS–17831– B

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BASE AND REPEATER STATIONS

406-420 MHz 12 W/45 W/75 W
450-470 MHz 12 W/20 W/45 W/75 W
470-512 MHz 12 W/20 W/40 W/60 W

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Communications Division

service publications
1301 E. Algonquin Road, Schaumburg, IL 60196

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68P81025E50-C
1/4/77-UP

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FOREWORD

1. SCOPE OF MANUAL

This manual is intended for use by experienced technicians familiar with similar types of equipment. It contains all service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date are incorporated by Instruction Manual Revisions (SMR). These SMR's are added to the manuals as the engineering changes are incorporated into the equipment.

2. MODEL AND KIT IDENTIFICATION

Motorola equipments are specifically identified by an overall model number on the nameplate. In most cases, assemblies and kits which make up the equipment also have kit model numbers stamped on them. When a production or engineering change is incorporated, revision suffix numerals are added to the affected kit model number. For example, a TLN4448A becomes a TLN4448A-1 with the first revision, TLN4448A-2 with the second revision, etc.

As diagrams are updated, information about the change is incorporated into a revision column. This revision column appears in the manual next to the parts list or, in some cases, on the diagram. It lists the reference number, part number, and description of the parts removed or replaced when the suffix number changed. With this information, the technician can find the information for the current version, and any previous version, of the equipment covered by the manual.

3. SERVICE

Motorola's National Service Organization offers one of the finest nation-wide installation and maintenance programs available to communication equipment users. This organization includes approximately 800 authorized Motorola Service Stations (MSS) located throughout the United States, each manned by one or more trained, FCC licensed technicians.

These MSS's are independently owned and operated and were selected by Motorola to service its customers. Motorola maintenance is available on either a time and material basis or on a periodic fixed-fee type arrangement.

The administrative staff of this organization consists of national, area and district service managers and district representatives, all of whom are Motorola employees with the objective to improve the service to our customers.

Should you wish to purchase a service contract for your Motorola equipment, contact your Motorola Service Representative, or write to:

National Service Manager
Motorola Communications Division
1303 E. Algonquin Road
Schaumburg, Illinois 60196

4. REPLACEMENT PARTS ORDERING

Motorola maintains a number of parts offices strategically-located throughout the United States. These facilities are staffed to process parts orders, identify part numbers, and otherwise assist in the maintenance and repair of Motorola Communications Division products.

Orders for all parts *except* crystals, channel elements, and "Vibrasender" ® and "Vibrasponder" ® resonant reeds should be sent to the nearest area parts center. Orders for instruction manuals should also be sent to the area parts center.

When ordering replacement parts or equipment information, the complete identification number should be included. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part, and sufficient description of the desired component to identify it.

Orders for crystals, channel elements, active filters, code plugs, and reeds should be sent directly to the factory address listed on the following page. Crystal and channel element orders should specify the crystal or channel element type number, crystal and carrier frequency, and the chassis model number in which the part is used.

Orders for active filters, code plugs, "Vibrasender" and "Vibrasponder" resonant reeds should specify type number and frequency, and should identify the owner/operator of the communications system in which these items are to be used.

5. ADDRESSES

5.1 GENERAL OFFICES

MOTOROLA, INC.
Communications Group Parts Dept.
1313 E. Algonquin Rd.,
Schaumburg, Illinois 60196
Phone: 312-576-6521
Executive Offices: 1303 E. Algonquin Rd.,
Schaumburg, Illinois 60196

5.2 U.S. ORDERS

WESTERN AREA PARTS
1170 Chess Drive, Foster City,
San Mateo, California 94404
Phone: 415-349-3111
TWX: 910-375-3877

MIDWEST AREA PARTS
10 W. North Ave.,
Lombard, Ill. 60148
Phone: 312-620-3000
TWX: 910-693-1592

MID-ATLANTIC AREA PARTS
6701 Elkridge Landing Road,
Linthicum, Maryland 21090
Phone: 301-796-8600

EAST CENTRAL AREA PARTS
12995 Snow Road,
Parma, Ohio 44130
Phone: 216-267-2210
TWX: 810-421-8845

EASTERN AREA PARTS
85 Harristown Road,
Glen Rock, New Jersey 07452
Phone: 201-447-4000
TWX: 710-988-5602

PACIFIC SOUTHWESTERN AREA PARTS
2333 Utah Avenue,
El Segundo, California 90245
Phone: 213-644-1101
TWX: 910-348-6278

SOUTHWESTERN AREA PARTS
3320 Belt Line Road,
Dallas, Texas 75234
Phone: 214-241-2151
TWX: 910-860-5505

SOUTHEASTERN AREA PARTS
5096 Panola
Industrial Blvd.
Decatur, Georgia 30032
Phone: 504-981-9800
TWX: 810-751-8300

5.3 CANADIAN ORDERS

CANADIAN MOTOROLA ELECTRONICS COMPANY
Parts Department
3125 Steeles Avenue,
East Willowdale, Ontario
Phone: 516-499-1441
TWX: 610-492-2713
Telex: 02-29944LD

5.4 ALL COUNTRIES EXCEPT U.S. AND CANADA

MOTOROLA, INC. OR MOTOROLA AMERICAS, INC.
International Parts Dept.
1313 E. Algonquin Road
Schaumburg, Illinois 60196 U.S.A.
Phone: 312-576-6492
TWX: 910-693-1592 or 1599
Telex: 722443 or 722424
Cable: MOTOL

5.5 FACTORY ADDRESS FOR CRYSTAL, CHANNEL ELEMENT, ACTIVE FILTER, CODE PLUGS AND RESONANT REED ORDERS

AIR MAIL ORDERS
Motorola, Inc.
Component Products Sales & Service
P.O. Box 66191
O'Hare International Airport
Chicago, Ill. 60666

REGULAR MAIL ORDERS AND CORRESPONDENCE
Motorola, Inc.
Component Products Sales & Service
2553 N. Edgington Street
Franklin Park, Illinois 60131

PERFORMANCE SPECIFICATIONS

GENERAL

Frequency Range 406-420 MHz, 450-512 MHz
No. of Frequencies: Up to 4 frequencies

406-420 MHz 450-470 MHz MODEL SERIES	CONTINUOUS MINIMUM RF POWER OUTPUT	MAXIMUM FINAL INPUT POWER	POWER INPUT REQUIREMENTS STANDBY 121 V, 60 Hz	POWER INPUT REQUIREMENTS TRANSMIT 121 V, 60 Hz	DC POWER STANDBY 13.6 V DC	DC POWER TRANSMIT 13.6 V DC
B/C34RCB	12 W	30 W	.85 amp	2.1 amp	1.5 amp	10.0 amp
B/C44RCB (Note 2)	20 W	60 W		2.6 amp		11.0 amp
B/C54RCB	45 W	120 W		3.8 amp		17.9 amp
B/C64RCB	75 W	180 W		6.1 amp		27.0 amp
470-512 MHz MODEL SERIES						
B/C34RCB	12 W	NOTE 1	.85 amp	NOTE 1	1.5 amp	NOTE 1
B/C44RCB	20 W					
B/C54RCB	40 W					
B/C64RCB	60 W					

NOTES:
1. Value same as comparable model above except as reduced to meet E.R.P. requirements.
2. Not available in 406-420 MHz range.

CABINET	DIMENSION (INCHES)	APPROXIMATE SHIPPING WEIGHT (LBS)
31-Inch "Compa-Station" Indoor Cabinet	22 W x 30-1/4 H x 10 D	150
41-Inch "Compa-Station" Indoor Cabinet	22 W x 41 H x 10 D	190
46-Inch "Compa-Station" Outdoor Cabinet	22 W x 46 H x 20 D (including Rain Shields)	180
60-Inch "Compa-Station" Indoor Cabinet	22 W x 60 H x 20 D	220
70-Inch Upright Indoor Cabinet	21-3/4 W x 70 H x 19-1/4 D	280
75-Inch Upright Cabinet	23-3/4 W x 74-5/8 H x 25-1/4 D (including Rain Shields)	365
Metering	Optional internal mounted meter used to measure all essential circuits for tuning and checking.	
	A single scale, 0-50 microampere meter with 2,000 ohms equivalent series resistance or Motorola portable test set can be used to measure all circuits essential to tuning and checking.	
	"B" models include DC metering and intercom as standard equipment.	

PERFORMANCE SPECIFICATIONS (Cont'd.)

TRANSMITTER

RF POWER OUTPUT	406-420 MHz 450-470 MHz 470-512 MHz	12 W 12 W 12 W	NOTE 2 20 W 20 W	45 W 45 W 40 W	75 W 75 W 60 W
OUTPUT IMPEDANCE			50 ohms		
OSCILLATOR FREQUENCY STABILITY			Channel element maintains oscillator frequency within ±0.0002% from -30°C to +60°C ambient (+25°C reference)		
TRANSMITTER SIDE BAND NOISE			85 dB @ ±25 kHz 100 dB @ ±1 MHz		
SPURIOUS & HARMONICS (CONDUCTED)			More than 85 dB below carrier		
MODULATION			15F2 and 16F3: ±5 kHz for 100% at 1000 Hz		
AUDIO SENSITIVITY			Local: 0.120 volt ±3 dB for 60% maximum deviation at 1000 Hz. Remote Telephone Line: -20 dBm max. for 60% maximum deviation at 1000 Hz		
FM NOISE			55 dB below 60% system deviation at 1000 Hz		
AUDIO RESPONSE			+1, -3 dB from 6dB/octave pre-emphasis, 300-3000 Hz, referenced to 1000 Hz		
AUDIO DISTORTION			Less than 2% at 1000 Hz; 60% system deviation		

"SENSITRON" RECEIVER

CHANNEL SPACING		25 kHz	
EIA MODULATION ACCEPTANCE		±7 kHz minimum	
FREQUENCY STABILITY		AFC channel element maintains receiver frequency within ±0.0002% of reference frequency from -30°C to +60°C ambient temperature (+25°C reference).	
INPUT IMPEDANCE		50 ohms	
SENSITIVITY	20 dB QUIETING	NO PREAMPLIFIER 0.5 uV	WITH PREAMPLIFIER 0.25 uV
	EIA SINAD	0.35 uV	0.175 uV
SELECTIVITY (EIA SINAD)		-90 dB @±25 kHz	
EIA SINAD INTERMODULATION		-85 dB	-80 dB
SPURIOUS AND IMAGE REJECTION		100 dB minimum	
SQUELCH SENSITIVITY CARRIER SQUELCH (adjustable)		.25 uV or less at threshold	.125 uV or less at threshold
TONE-CODED SQUELCH		.25 uV or less	.125 uV or less
DIGITAL-CODED SQUELCH		.25 uV or less	.125 uV or less

PERFORMANCE SPECIFICATIONS (Cont'd.)

AUDIO (TELEPHONE LINE)	OUTPUT	+18 dBm at 600 ohms
	RESPONSE	+1, -3 dB
	DISTORTION	3% at 1000 Hz
	HUM & NOISE	-55 dB
	LOCAL SPEAKER	10 watts at 8 ohms output available

FCC LICENSE DESIGNATION

Transmitter			
MODEL	450-470 MHz	470-494 MHz	494-512 MHz
B/C 64 Series			
75 Watt	CC4224C	---	---
60 Watt	---	CC4224C-1	CC4224C-2
B/C 54 Series			
45 Watt	CC4223C	---	---
40 Watt	---	CC4223C-1	CC4223C-2
B/C 44 Series			
20 Watt	CC4222C	CC4222C-1	CC4222C-2
B/C 34 Series			
12 Watt	CC4221C	CC4221C-1	CC4221C-2

Receiver	
Non-Shifted IF w/o Preampl	RC0080
Non-Shifted IF w Preampl	RC0081
Shifted IF w/o Preampl	RC0082
Shifted IF w Preampl	RC0083

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

EPS-17817-A

SAFETY INFORMATION

The United States Department of Labor, through the provisions of the Occupational Safety and Health Act of 1970 (OSHA), has established an electromagnetic radiation safety standard which applies to this equipment. Normal use of this radio will result in exposures far below the OSHA limit. However, the following precautions are recommended:

DO NOT approach the antenna closer than four inches for omni–directional antennas or four feet for all other antennas when the transmitter is operative.

DO NOT operate the transmitter unless all rf connectors are secure and any open connectors are properly terminated with a leakproof load.

NEPS–21233–O

MOTOROLA

MODEL SERIES BREAKDOWN CHART

FOR

"MICOR" "COMPA-STATION" AND

UPRIGHT STATIONS

406-420 AND 450-512 MHz

MODEL	ITEM DESCRIPTION
	EXCITER/1ST BANDPASS FILTER
TLE1721B	EXCITER/1ST BANDPASS FILTER (406-420 MHz)
TLE1723B	EXCITER/1ST BANDPASS FILTER (450-470 MHz)
TLE1724B	EXCITER/1ST BANDPASS FILTER (470-494 MHz)
TLE1725B	EXCITER/1ST BANDPASS FILTER (494-512 MHz)
	TRIPLER/LOW LEVEL AMPLIFIER
TLE1601A	TRIPLER/LOW LEVEL AMPLIFIER (406-420 MHz)
TLE1603A	TRIPLER/LOW LEVEL AMPLIFIER (450-470 MHz)
TLE1604A	TRIPLER/LOW LEVEL AMPLIFIER (470-494 MHz)
TLE1605A	TRIPLER/LOW LEVEL AMPLIFIER (494-512 MHz)
	ANTENNA NETWORK
TLE1661A	Base Stations, 406-420 MHz
TLE1663A	Base Stations, 450-470 MHz
TLE1664A	Base Stations, 470-494 MHz
TLE1665A	Base Stations, 494-512 MHz
TLE1671A	RPTR Stations, 406-420 MHz
TLE1673A	RPTR Stations, 450-470 MHz
TLE1674A	RPTR Stations, 470-494 MHz
TLE1675A	RPTR Stations, 494-512 MHz
	POWER AMPLIFIER
TLE1681A	12-WATT POWER AMPLIFIER (406-420 MHz)
TLE1683A	12-WATT POWER AMPLIFIER (450-470 MHz)
TLE1684A	12-WATT POWER AMPLIFIER (470-512 MHz)
TLE1693A	20-WATT POWER AMPLIFIER (450-470 MHz)
TLE1694A	20-WATT POWER AMPLIFIER (470-512 MHz)
TLE1701A	45-WATT POWER AMPLIFIER (406-420 MHz)
TLE1703A	45-WATT POWER AMPLIFIER (450-470 MHz)
TLE1704A	45-WATT POWER AMPLIFIER (470-512 MHz)
TLE1711A	75-WATT POWER AMPLIFIER (406-420 MHz)
TLE1713A	75-WATT POWER AMPLIFIER (450-470 MHz)
TLE1714A	75-WATT POWER AMPLIFIER (470-512 MHz)
	RECEIVER RF & IF
TRE1201BA	RCVR RF & IF (406-420 MHz)
TRE1203BA	RCVR RF & IF (450-470 MHz)
TRE1204BA	RCVR RF & IF (470-494 MHz)
TRE1205BA	RCVR RF & IF (494-512 MHz)
	2ND RECEIVER
TLN1738A	2nd RECEIVER CHASSIS
	UNIFIED CONTROL CHASSIS
TCN1187A	UNIFIED CONTROL CHASSIS (RPTR STATIONS)
TCN1148A	UNIFIED CONTROL CHASSIS (BASE STATIONS)

MODEL	ITEM DESCRIPTION
	EXCITER/1ST BANDPASS FILTER
TLD5491A	EXCITER BOARD (135.3-140 MHz)
TLD5492A	EXCITER BOARD (150-170.6 MHz)
TFD6371A	1ST BANDPASS FILTER (135.3-140 MHz)
TFD6373A	1ST BANDPASS FILTER (150.0-156.6 MHz)
TFD6374A	1ST BANDPASS FILTER (156.6-164.6 MHz)
TFD6375A	1ST BANDPASS FILTER (164.6-170.6 MHz)
	TRIPLER/LOW LEVEL AMPLIFIER
TLN5650	CHASSIS AND HARDWARE KIT
TLE8391A	TRIPLER/AMPLIFIER (406-420 MHz)
TLE8393A	TRIPLER/AMPLIFIER (450-470 MHz)
TLE8394A	TRIPLER/AMPLIFIER (470-494 MHz)
TLE8395A	TRIPLER/AMPLIFIER (494-512 MHz
TFE6151A	2ND BANDPASS FILTER (406-420 MHz)
TFE6153A	2ND BANDPASS FILTER (450-470 MHz)
TFE6154A	2ND BANDPASS FILTER (470-494 MHz)
TFE6155A	2ND BANDPASS FILTER (494-512 MHz)
	ANTENNA NETWORK
TLE8281A	CHASSIS AND HARDWARE KIT (406-420 MHz)
TLE8283A	CHASSIS AND HARDWARE KIT (450-470 MHz)
TLE8284A	CHASSIS AND HARDWARE KIT (470-494 MHz)
TLE8285A	CHASSIS AND HARDWARE KIT (494-512 MHz)
TLN5651A	REED SWITCH
TLE8291A	CHASSIS AND HARDWARE KIT (406-420 MHz)
TLE8293A	CHASSIS AND HARDWARE KIT (450-470 MHz)
TLE8294A	CHASSIS AND HARDWARE KIT (470-494 MHz)
TLE8295A	CHASSIS AND HARDWARE KIT (494-512 MHz)
TLN5652A	ANTENNA NETWORK BOARD
TFE6361A	HARMONIC FILTER (406-420 MHz)
TFE6363A	HARMONIC FILTER (450-512 MHz)
	UNIFIED CONTROL CHASSIS
TLN5649A	CHASSIS
TLN5644A	UNIFIED CHASSIS INTERCONNECT BOARD
TLN5645A	TRANSMITTER INTERCONNECT BOARD (RF
TLN5646A	RECEIVER INTERCONNECT BOARD (RPTR)
TLN5647A	TRANSMITTER INTERCONNECT BOARD (BA
TLN5648A	RECEIVER INTERCONNECT BOARD (BASE)
	POWER AMPLIFIER
TLE8301A	12-WATT PA (406-420 MHz)
TLE8303A	12-WATT PA (450-470 MHz)
TLE8304A	12-WATT PA (470-512 MHz)
TKN6766A	CABLE KIT
TLE8313A	20-WATT PA (450-512 MHz)
TKN6767A	CABLE KIT
TLE8321A	45-WATT PA (406-420 MHz)
TLE8323A	45-WATT PA (450-512 MHz)
TLE8331A	75-WATT PA (406-420 MHz)
TLE8333A	75-WATT PA (450-470 MHz)
TLE8334A	75-WATT PA (470-512 MHz)
TKN6768A	CABLE KIT
	RECEIVER RF & IF
TLE8021A	RF DECK (406-420 MHz)
TLE8023A	RF DECK (450-470 MHz)
TLE8024A	RF DECK (470-494 MHz)
TLE8025A	RF DECK (494-512 MHz)
TLE8031B	RF & IF BOARD (406-420 MHz)
TLE8032B	RF & IF BOARD (450-494 MHz)
TLE8033B	RF & IF BOARD (494-512 MHz)
	2ND RECEIVER
TLN5653A	CHASSIS AND HARDWARE
TLN5655A	INTERCONNECT BOARD

CODE:

X = ONE SUPPLIED

2 = TWO SUPPLIED

3 = CABINET HARDW
INCORPORATE A
RECEIVER STATI
TWO-RECEIVER S
INCORPORATE A
RECEIVER STATI
RECEIVER STATI

4 = FOUR SUPPLIED

0 = TWO KXN1024A R
FREQUENCIES AR
MULTIPLE THER
MENT IS USED IN
ELEMENT IS USE
RCVR IS SHIFTEI

* INDICATES A MODE
REFER TO MODEL S

"M

B/C34RCB-1105A

CHANNEL ELEMENT (RCVR)

RF
OUTP
POWE

B OR C
B = UPRIGHT STATION
C = "COMPA-STATION" R

STATION MODEL	SC	KXN1024A	TKN6802A	TLE8340A	TLN1738A	TPN1110B	TRN6199A	--	TLE1680A SERIES	TKN6803A	TLN4926AV	TLE1690A SERIES	TKN6804A	TLE1700A SERIES	TKN6804A	TLE1710A SERIES	TKN6804A	THN6194B	TLN1739A	TLN5134A	TKN6190A	TLN5264	THN6141A	THN6142A
			RECEIVER CABLE KIT(BETWEEN RECEIVER & ANTENNA NETWORK)	2-RCVR COUPLER	2ND RCVR CHASSIS NOTE	POWER SUPPLY	HARDWARE KIT	CABINET HARDWARE KIT	* 12-WATT POWER AMPLIFIER	12-WATT CABLE KIT	POWER CONTROL BOARD	* 20-WATT POWER AMPLIFIER	75-WATT CABLE KIT	* 45-WATT POWER AMPLIFIER	75-WATT CABLE KIT	* 75-WATT POWER AMPLIFIER	75-WATT CABLE KIT	70-INCH UPRIGHT CABINET (FORMERLY THN6194A)	METERING CHASSIS	METER PANEL	CABINET HARDWARE KIT	POWER JUNCTION BOX	31-INCH "COMPA-STATION" CABINET (C34, SINGLE-RCVR STATIONS ONLY)	41-INCH "COMPA-STATION" CABINET (ALL OTHER "COMPA-STATION" MODELS)
B/C64RCB1105A		X			X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB1106A		X			X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB1125A		X			X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB1126A		X			X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB1145A			X	X	X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB1146A			X	X	X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB1196A		X			X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB3105A	"PL" T	X			X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB3106A	"PL" T	X			X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB3125A	"PL" T	X			X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB3126A	"PL" T	X			X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB3145A	"PL" T	X	X	X	X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
B/C64RCB3146A	"PL" T	X	X	X	X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
B/C64RCB3196A	"PL" T	X			X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB6105A	"DIGIT	X			X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCV6106A	"DIGIT	X			X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB6125A	"DIGIT	X			X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCV6126A	"DIGIT	X			X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB6145A	"DIGIT	X	X	X	X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
B/C64RCB6146A	"DIGIT	X	X	X	X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
B/C64RCB6196A	"DIGIT	X			X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB1105AT					X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB1106AT					X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB3105AT	"PL" T				X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB3106AT	"PL" T				X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB6105AT	"DIGIT				X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
B/C64RCB6106AT	"DIGIT				X	X	3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

B/C34 MODELS ONLY

B/C44 MODELS ONLY (EXCEPT AS NOTED)

B/C54 MODELS ONLY (EXCEPT AS NOTED)

B/C64 MODELS ONLY (EXCEPT AS NOTED)

B MODELS ONLY

C MODELS ONLY

EPS-17816-B

MOTOROLA

MODEL SERIES BREAKDOWN CHART

FOR

"MICOR" "COMPA-STATION" AND

UPRIGHT STATIONS

406-420 AND 450-512 MHz

MODEL	ITEM DESCRIPTION
	EXCITER/1ST BANDPASS FILTER
TLD5491A	EXCITER BOARD (135.3-140 MHz)
TLD5492A	EXCITER BOARD (150-170.6 MHz)
TFD6371A	1ST BANDPASS FILTER (135.3-140 MHz)
TFD6373A	1ST BANDPASS FILTER (150.0-156.6 MHz)
TFD6374A	1ST BANDPASS FILTER (156.6-164.6 MHz)
TFD6375A	1ST BANDPASS FILTER (164.6-170.6 MHz)
	TRIPLER/LOW LEVEL AMPLIFIER
TLN5650	CHASSIS AND HARDWARE KIT
TLE8391A	TRIPLER/AMPLIFIER (406-420 MHz)
TLE8393A	TRIPLER/AMPLIFIER (450-470 MHz)
TLE8394A	TRIPLER/AMPLIFIER (470-494 MHz)
TLE8395A	TRIPLER/AMPLIFIER (494-512 MHz
TFE6151A	2ND BANDPASS FILTER (406-420 MHz)
TFE6153A	2ND BANDPASS FILTER (450-470 MHz)
TFE6154A	2ND BANDPASS FILTER (470-494 MHz)
TFE6155A	2ND BANDPASS FILTER (494-512 MHz)
	ANTENNA NETWORK
TLE8281A	CHASSIS AND HARDWARE KIT(406-420 MHz)
TLE8283A	CHASSIS AND HARDWARE KIT (450-470 MHz
TLE8284A	CHASSIS AND HARDWARE KIT (470-494 MHz
TLE8285A	CHASSIS AND HARDWARE KIT (494-512 MHz
TLN5651A	REED SWITCH
TLE8291A	CHASSIS AND HARDWARE KIT (406-420 MHz
TLE8293A	CHASSIS AND HARDWARE KIT (450-470 MHz
TLE8294A	CHASSIS AND HARDWARE KIT (470-494 MHz
TLE8295A	CHASSIS AND HARDWARE KIT (494-512 MHz
TLN5652A	ANTENNA NETWORK BOARD
TFE6361A	HARMONIC FILTER (406-420 MHz)
TFE6363A	HARMONIC FILTER (450-512 MHz)
	UNIFIED CONTROL CHASSIS
TLN5649A	CHASSIS
TLN5644A	UNIFIED CHASSIS INTERCONNECT BOARD
TLN5645A	TRANSMITTER INTERCONNECT BOARD (RF
TLN5646A	RECEIVER INTERCONNECT BOARD (RPTR)
TLN5647A	TRANSMITTER INTERCONNECT BOARD (BA
TLN5648A	RECEIVER INTERCONNECT BOARD (BASE)
	POWER AMPLIFIER
TLE8301A	12-WATT PA (406-420 MHz)
TLE8303A	12-WATT PA (450-470 MHz)
TLE8304A	12-WATT PA (470-512 MHz)
TKN6766A	CABLE KIT
TLE8313A	20-WATT PA (450-512 MHz)
TKN6767A	CABLE KIT
TLE8321A	45-WATT PA (406-420 MHz)
TLE8323A	45-WATT PA (450-512 MHz)
TLE8331A	75-WATT PA (406-420 MHz)
TLE8333A	75-WATT PA (450-470 MHz)
TLE8334A	75-WATT PA (470-512 MHz)
TKN6768A	CABLE KIT
	RECEIVER RF & IF
TLE8021A	RF DECK (406-420 MHz)
TLE8023A	RF DECK (450-470 MHz)
TLE8024A	RF DECK (470-494 MHz)
TLE8025A	RF DECK (494-512 MHz)
TLE8031B	RF & IF BOARD (406-420 MHz)
TLE8032B	RF & IF BOARD (450-494 MHz)
TLE8033B	RF & IF BOARD (494-512 MHz)
	2ND RECEIVER
TLN5653A	CHASSIS AND HARDWARE
TLN5655A	INTERCONNECT BOARD

MODEL	ITEM DESCRIPTION
TLE1721B	EXCITER/1ST BANDPASS FILTER (406-420 MHz)
TLE1723B	EXCITER/1ST BANDPASS FILTER (450-470 MHz)
TLE1724B	EXCITER/1ST BANDPASS FILTER (470-494 MHz)
TLE1725B	EXCITER/1ST BANDPASS FILTER (494-512 MHz)
TLE1601A	TRIPLER/LOW LEVEL AMPLIFIER (406-420 MHz)
TLE1603A	TRIPLER/LOW LEVEL AMPLIFIER (450-470 MHz)
TLE1604A	TRIPLER/LOW LEVEL AMPLIFIER (470-494 MHz)
TLE1605A	TRIPLER/LOW LEVEL AMPLIFIER (494-512 MHz)
TLE1661A	Base Stations, 406-420 MHz
TLE1663A	Base Stations, 450-470 MHz
TLE1664A	Base Stations, 470-494 MHz
TLE1665A	Base Stations, 494-512 MHz
TLE1671A	RPTR Stations, 406-420 MHz
TLE1673A	RPTR Stations, 450-470 MHz
TLE1674A	RPTR Stations, 470-494 MHz
TLE1675A	RPTR Stations, 494-512 MHz
TLE1681A	12-WATT POWER AMPLIFIER (406-420 MHz)
TLE1683A	12-WATT POWER AMPLIFIER (450-470 MHz)
TLE1684A	12-WATT POWER AMPLIFIER (470-512 MHz)
TLE1693A	20-WATT POWER AMPLIFIER (450-470 MHz)
TLE1694A	20-WATT POWER AMPLIFIER (470-512 MHz)
TLE1701A	45-WATT POWER AMPLIFIER (406-420 MHz)
TLE1703A	45-WATT POWER AMPLIFIER (450-470 MHz)
TLE1704A	45-WATT POWER AMPLIFIER (470-512 MHz)
TLE1711A	75-WATT POWER AMPLIFIER (406-420 MHz)
TLE1713A	75-WATT POWER AMPLIFIER (450-470 MHz)
TLE1714A	75-WATT POWER AMPLIFIER (470-512 MHz)
TRE1201BA	RCVR RF & IF (406-420 MHz)
TRE1203BA	RCVR RF & IF (450-470 MHz)
TRE1204BA	RCVR RF & IF (470-494 MHz)
TRE1205BA	RCVR RF & IF (494-512 MHz)
TLN1738A	2nd RECEIVER CHASSIS
TCN1187A	UNIFIED CONTROL CHASSIS (RPTR STATIONS)
TCN1148A	UNIFIED CONTROL CHASSIS (BASE STATIONS)

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MOTOROLA

STATION MODEL CHART
FOR
"MICOR "COMPA-STATION" AND UPRIGHT STATIONS
406-420 MHz and 450-512 MHz

CODE:

- [X] = ONE SUPPLIED
- [2] = TWO SUPPLIED
- [3] = CABINET HARDWARE KITS. B/C34 MODELS INCORPORATE A TRN6197A KIT WITH SINGLE-RECEIVER STATIONS OR A TRN6198A KIT WITH TWO-RECEIVER STATIONS. B/C44-54-64 MODELS INCORPORATE A TRN6199A KIT WITH SINGLE-RECEIVER STATIONS OR A TRN6200A KIT WITH TWO-RECEIVER STATIONS.
- [4] = FOUR SUPPLIED
- [0] = TWO KXN1024A RCVR ELEMENTS SUPPLIED UNLESS RCVR CARRIER FREQUENCIES ARE SEPARATED BY 11.7 MHz ±25 kHz (OR A SUB-MULTIPLE THEREOF). IN THIS CASE, A KXN1024A CHANNEL ELEMENT IS USED IN THE FIRST RCVR AND A KXN1049A CHANNEL ELEMENT IS USED IN THE SECOND RCVR. THE IF OF THE SECOND RCVR IS SHIFTED USING A TLE8610A SHIFTED IF KIT.

* INDICATES A MODEL SERIES.
REFER TO MODEL SERIES BREAKDOWN CHART

B/C34RCB-1105A

STATION MODEL VARIATIONS
- A = BASE STATION
- AT = RPTR (RT) STATION
- 5 = DC CONTROL
- 6 = TONE CONTROL
- 0 = T1-R1 (ONE XMIT CHANNEL -ONE RECEIVE CHANNEL)
- 2 = T2-R2
- 4 = T2-2R1 (TWO TRANSMIT CHANNELS-(2) ONE CHANNEL RECEIVERS)
- 9 = T4-R4 (FOUR TRANSMIT CHANNELS -FOUR RECEIVE CHANNELS)
- 1 = CARRIER SQUELCH
- 3 = "PL" TONE-CODED SQUELCH
- 6 = "PL" DIGITAL-CODED SQUELCH

FREQUENCY RANGE (MHz)

RF OUTPUT POWER	406-420	450-470	470-512
3 = 12 W	12 W	12 W	12 W
4 = --	20 W	20 W	--
5 = 45 W	45 W	40 W	60 W
6 = 75 W	75 W	60 W	--

B OR C
B = UPRIGHT STATION
C = 'COMPA-STATION' RADIO

STATION MODEL	DESCRIPTION: SQUELCH TYPE	DESCRIPTION: CONTROL TYPE	DESCRIPTION: OPERATING CHANNELS
BASE STATIONS			
B/C64RCB1105A	CARRIER	DC	T1-R1
B/C64RCB1106A	CARRIER	TONE	T1-R1
B/C64RCB1125A	CARRIER	DC	T2-R2
B/C64RCB1126A	CARRIER	TONE	T2-R2
B/C64RCB1145A	CARRIER	DC	T2-2R1
B/C64RCB1146A	CARRIER	TONE	T2-2R1
B/C64RCB1194A	CARRIER	DC	T4-R4
B/C64RCB3105A	"PL" TONE-CODED	DC	T1-R1
B/C64RCB3106A	"PL" TONE-CODED	TONE	T1-R1
B/C64RCB3125A	"PL" TONE-CODED	DC	T2-R2
B/C64RCB3126A	"PL" TONE-CODED	TONE	T2-R2
B/C64RCB3145A	"PL" TONE-CODED	DC	T2-2R1
B/C64RCB3146A	"PL" TONE-CODED	TONE	T2-2R1
B/C64RCB3194A	"PL" TONE-CODED	TONE	T4-R4
B/C64RCB6105A	"DIGITAL PRIVATE-LINE"	DC	T1-R1
B/C64RCB6106A	"DIGITAL PRIVATE-LINE"	TONE	T1-R1
B/C64RCB6125A	"DIGITAL PRIVATE-LINE"	DC	T2-R2
B/C64RCB6126A	"DIGITAL PRIVATE-LINE"	TONE	T2-R2
B/C64RCB6145A	"DIGITAL PRIVATE-LINE"	DC	T2-2R1
B/C64RCB6146A	"DIGITAL PRIVATE-LINE"	TONE	T2-2R1
B/C64RCB6194A	"DIGITAL PRIVATE-LINE"	TONE	T4-R4
REPEATER (RT) STATIONS			
B/C64RCB1105AT	CARRIER	DC	T1-R1
B/C64RCB1106AT	CARRIER	TONE	T1-R1
B/C64RCB3105AT	"PL" TONE-CODED	DC	T1-R1
B/C64RCB3106AT	"PL" TONE-CODED	TONE	T1-R1
B/C64RCB6105AT	"DIGITAL PRIVATE-LINE"	DC	T1-R1
B/C64RCB6106AT	"DIGITAL PRIVATE-LINE"	TONE	T1-R1

KIT	DESCRIPTION
TCN1143A	* UNIFIED CONTROL CHASSIS (BASE)
TCN1187A	* UNIFIED CONTROL CHASSIS (RPTR)
TLE1600A SERIES	* TRIPLER/LOW LEVEL AMPLIFIER
TLE1660A SERIES	* ANTENNA NETWORK (BASE)
TLE1670A SERIES	* ANTENNA NETWORK (RPTR)
TLE1720B SERIES	* EXCITER & 1ST BANDPASS FILTER
TLN4926A	POWER CONTROL BOARD
TLN5731A	TONE "PRIVATE-LINE" ENCODER
TTN6003A	"PL" DIGITAL-CODED SQUELCH DECODER
TLN5725A	"PL" DIGITAL-CODED SQUELCH ENCODER (DUPLEX)
TRN6005A	CODE PLUG (DIGITAL-CODED SQUELCH ENCODER (SIMPLEX)
KXN1052A	CHANNEL ELEMENT (XMIT)
TLN6824A	"VIBRASENDER" RESONANT REED
TRN6188A	"PL" ENCODER HARDWARE KIT
TLN5654A	"PL" DECODER HARDWARE KIT
TLN4635B	STATION CONTROL MODULE
TLN4669B	LINE DRIVER MODULE (1REC-2-WIRE)
TLN4670B	LINE DRIVER MODULE (2 REC)
TLN4661A	DC TRANSFER MODULE (IF-CS-F1)
TLN4603A	DC TRANSFER MODULE (C2-R2)
TLN4659A	DC TRANSFER MODULE (F1-"PL")
TLN4660A	DC TRANSFER MODULE (F2-R2 MUTE)
TLN12458	GUARD TONE MODULE
TLN4658A	F1 TONE CONTROL MODULE
TLN4638A	F1-"PL" TONE CONTROL MODULE
TLN4605A	F2 TONE CONTROL MODULE
TLN1248A	C2-R2 TONE CONTROL MODULE
TLN4636A	TIME-OUT TIMER MODULE
TLN5292A	4-FREQUENCY CONTROL MODULE
TLN5293A	F1 CONTROL MODULE (4F-CS)
TLN5294A	F1-"PL" CONTROL MODULE (4F-"PL")
TLN8799A	SERVICE BOARD
TRN6338A	5-VOLT REGULATOR KIT
TLN4602A	SQUELCH GATE MODULE
TRE1200BA SERIES	* RCVR RF & IF
TRN6006A	RCVR AUDIO & SQUELCH BOARD
TLN4290B	RCVR AUDIO POWER AMPLIFIER
TRN6092A	"PL" TONE-CODED SQUELCH DECODER
TLN5729A	"PL" DIGITAL-CODED SQUELCH DECODER
TLN8381A	"VIBRASPONDER" RESONANT REED
KXN1024A	CHANNEL ELEMENT (RCVR)
TKN6802A	RECEIVER CABLE KIT (BETWEEN RECEIVER & ANTENNA NETWORK)
TLE8340A	2-RCVR COUPLER
TLN1738A	2ND RCVR CHASSIS NOTE
TPN1110B	POWER SUPPLY
TRN6199A	HARDWARE KIT
--	CABINET HARDWARE KIT
TLE1680A SERIES	* 12-WATT POWER AMPLIFIER
TKN6803A	12-WATT CABLE KIT
TLN4926AV	POWER CONTROL BOARD
TLE1690A SERIES	* 20-WATT POWER AMPLIFIER
TKN6804A	75-WATT CABLE KIT
TLE1700A SERIES	* 45-WATT POWER AMPLIFIER
TKN6804A	75-WATT CABLE KIT
TLE1710A SERIES	* 75-WATT POWER AMPLIFIER
TKN6804A	75-WATT CABLE KIT
THN6194B	70-INCH UPRIGHT CABINET (FORMERLY THN6194A)
TLN1739A	METERING CHASSIS
TLN5134A	METER PANEL
TKN6190A	CABINET HARDWARE KIT
TLN5264	POWER JUNCTION BOX
THN6141A	31-INCH "COMPA-STATION" CABINET (C34, SINGLE-RCVR STATIONS ONLY)
THN6142A	41-INCH "COMPA-STATION" CABINET (ALL OTHER "COMPA-STATION" MODELS)

ALL MODELS | B/C34 MODELS ONLY | B/C44 MODELS ONLY (EXCEPT AS NOTED) | B/C54 MODELS ONLY (EXCEPT AS NOTED) | B/C64 MODELS ONLY (EXCEPT AS NOTED) | B MODELS ONLY | C MODELS ONLY

EPS-17816-B

FACTORY-INSTALLED OPTIONS

OPTION PLAN NUMBER OF OPTIONAL KIT NUMBER	DESCRIPTION	PUBLICATION REFERENCE	
		APPLICABLE SECTION WITHIN THIS MANUAL	PART NUMBER OF SEPARATE PUBLICATION
DC REMOTE CONTROL STATION OPTIONS			
C63	TLN4637A Paging Module	None	68P81025E60
C143	TLN4664A Repeater Control Module	None	68P81025E60
TONE REMOTE CONTROL STATION OPTIONS			
C56 OR C63	TLN4667A F2-R2 Mute Control Module	None	68P81025E60
	TLN1253A Paging Control Module	None	68P81025E60
TLN1249A OR TLN1250A OR TLN1251A	Squelch Control Module	None	68P81025E60
	Repeater Control Module	None	68P81025E60
	PL Control Module	None	68P81025E60
TLN1252A	"Wild Card" Module (See Note 3)	None	68P81025E60
C170	Guard Tone Keying	None	68P81025E60
OPTIONS APPLICABLE TO BOTH DC AND TONE REMOTE CONTROL STATIONS			
C12	TLE8191A/2A RF Preamplifier	Receiver RF & IF	None
C31	Transmit Only Station (Delete Receiver)	None	None
C140	AND Squelch Control	Receiver Interconnect Unit	None
C144 OR C144AB	TLN4668A 4-Wire Audio (1-Rcvr)	None	68P81025E60
	TLN4668A 4-Wire Audio (2-Rcvr)	None	68P81025E60
C145	TLN1460A TAC Encoder (See Note 5)	None	68P81104E73
C150	Base (RA) Operation	None	68P81105E08
C158	Multiple PL Transmit	None	68P81106E30
C261	Multiple PL Receive	None	68P81106E30
C262	Multiple PL Repeat	None	68P81106E30
C263	Multiple PL Transmit & Receive	None	68P81106E30
TLN1181A	Single-Tone Decoder Module	None	68P81025E60
TLN4636A	Time-Out Timer Module (See Note 6)	None	68P81025E60
TLN1740A	DC Metering W/Monitor Intercom (Note 7)	None	None
TLN1745A	Service Intercom W/Speaker (Notes 7 and 8)	None	None
C160	Repeater (RA) Operation	None	68P81105E08
C27	46-Inch Outdoor Cabinet	Installation	None
C180	60-Inch Indoor Cabinet	Installation	None
C36	75-Inch Outdoor Cabinet	Installation	None
C38	120/220/240-Volt AC 50/60 Hz Power Supply	None	68P81104E92
C28	120-Volt AC/12-Volt DC Power Supply	None	68P81104E92
C29	Battery Saver/Alarm	None	68P81104E92
C181, 182, 183	Duplexer	None	68P81102E96
C75	Omit Time-Out Timer Module	None	None
TLN4151A	Relay Kit	None	68P81025E60
C149	Meter Kit	Station Maintenance	None

NOTES:

1. The options listed are not necessarily compatible with each other or with each type of station. Consult your Motorola representative for compatibility details.
2. Other options may become available after the printing of this instruction manual. Consult your Motorola representative for a complete listing of the current options available for your station.
3. One to four TLN4151A Relay Kits may be used with this option to provide one to four form "C" contact closures for operation of external equipment.
4. One TLN4151A Relay Kit may be used with this option to provide a form "C" contact closure for operation of external equipment.
5. This option also replaces the TLN4669A 2-Wire Audio with the TLN4668A 4-Wire Audio.
6. Option to base stations; supplied with repeater stations.
7. Option to "Compa-Station" Radios only.
8. TLN1745A Service Intercom Kit is identical to TLN1740A DC Metering W/Monitor Intercom Kit but less dc metering feature.

TAB 1. DESCRIPTION

TAB 2. INSTALLATION

TAB 3. STATION MAINT
POWER SUPPLY

STATION MAINTENANCE
MAINTENANCE LOG SHEET
METERING & INTERCOM
POWER SUPPLY

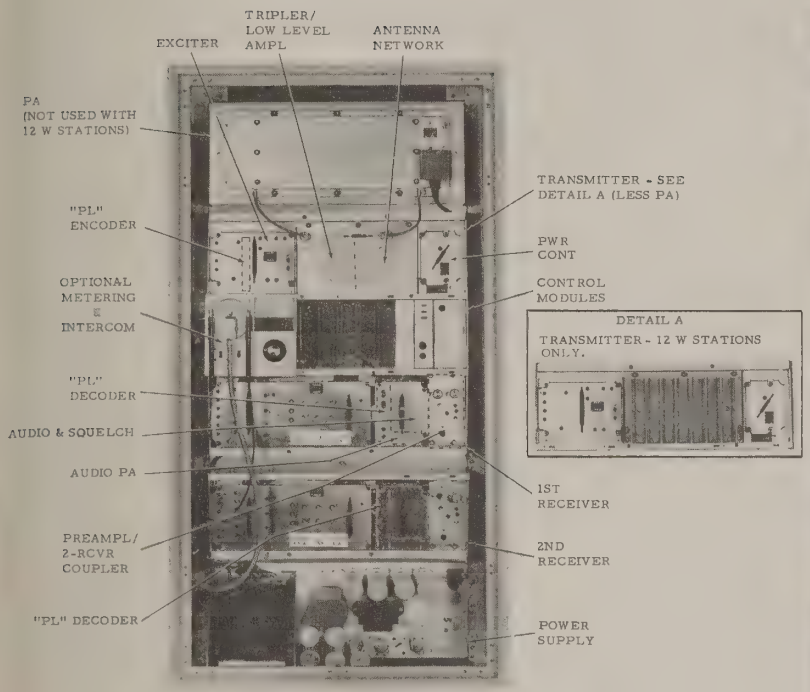
TAB 4. TRANSMITTER

ALIGNMENT
MAINTENANCE
INTERCONNECT BOARD
EXCITER/1ST BANDPASS FILTER
POWER AMPLIFIERS
POWER CONTROL BOARD/
ANTENNA NETWORK/CONTROL STAGE
"PRIVATE–LINE" ENCODERS

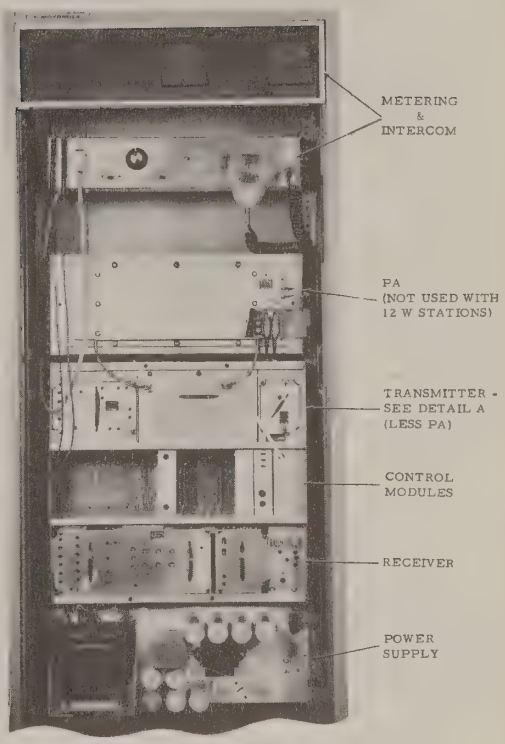
TAB 5. RECEIVER

ALIGNMENT
MAINTENANCE
INTERCONNECT BOARD
RF & IF
AUDIO & SQUELCH
"PRIVATE–LINE" DECODERS

DESCRIPTION



TYPICAL "COMPA-STATION" RADIO



FBEPS-17735-A

TYPICAL UPRIGHT STATION

1. MANUAL USAGE

This manual describes all aspects of 406-420 MHz and 450-470 MHz "Micor" type Upright and "Compa-Station" radios except remote control and station applications. Separate CONTROL and APPLICATIONS manual 68P81025E60 describes how these stations are remotely controlled and outlines the various types of base and repeater stations and their applications.

2. EQUIPMENT DESCRIPTION INTRODUCTION

2.1 These Motorola "Micor" type base and repeater (RT) stations operate in the 406-420 MHz and 450-512 MHz range and are available in two basic model configurations -- "Compa-Station" models and Upright models. Basic electrical characteristics of both are identical; the primary differences being that the upright models include a larger cabinet with hinged doors (front and back) and built-in metering with monitor intercom. "Compa-Station" models are shorter, incorporate non-hinged doors, and built-in metering with monitor intercom is available as an option. ("Compa-Station" metering is unique from upright station metering.)

2.2 Many models are available as shown in the station model chart at the front of this manual which designates equipment operational differences. These differences include transmitter rf power output level, type of receiver squelch, number of operating frequencies, type of remote control, etc.

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3. TRANSMITTER

The transmitter generates a frequency modulated rf carrier signal of various power output levels depending upon the model. Refer to the following station block diagram for functional operation. The transmitter consists of the following items:

NOTE

Stations in the 470-512 MHz band are FCC-licensed to operate at or below a specified effective radiated power (ERP). The ERP of the station is related to the rf power output of the transmitter, antenna transmission line loss, antenna height and antenna gain. The maximum rf power output of the transmitter that will be permitted, without violating the licensed ERP for each specific station, must be determined by a communications specialist. This rf power figure may be equal to or below the maximum capability of the station. Record the figure for reference in future servicing and alignment of the station.

--Channel Element - An unheated, temperature-compensated crystal oscillator plug-in module (channel element) provides a stable fundamental rf frequency for the transmitter. One channel element is used for each transmitter frequency.

--Exciter - The exciter provides the low power excitation signal for the transmitter. An "IDC" (Instantaneous Deviation Control) circuit amplifies and limits audio signals from the microphone (or line) to prevent over deviation. Amplified audio is applied to the channel element to produce direct fm modulation. Multipliers in the exciter multiply the channel element frequency 12 times to generate an output frequency signal(s) in the 135 to 171 MHz band.

--First Bandpass Filter - The first bandpass filter couples 135-171 MHz signals from the exciter to the tripler/low level amplifier and attenuates any harmonics outside this band.

--Tripler/Low Level Amplifier - Exciter output frequency is tripled in this stage and amplified to drive the following power amplifier.

--Second Bandpass Filter - This filter is located electrically between the tripler and low level amplifier. This filter couples 406-512 MHz signals from the tripler to the low level amplifier and attenuates any harmonics outside this band.

--Power Amplifier - The low power output of the tripler/ low level amplifier is amplified to the rated power output of the transmitter in this solid-state power amplifier. Class C amplifiers are used which are cut off until signal drive is applied. A controlled amplifier stage regulates the amount of signal drive to prevent overdissipation in the final amplifier stages. An input from the power control board controls the amount of gain.

--Power Control Board - The power control board automatically and instantaneously regulates the transmitter output power. It maintains output power should source voltage vary, and progressively reduces power when VSWR increase. The output of the board is applied to the controlled amplifier stage in the power amplifier to regulate the amount of gain.

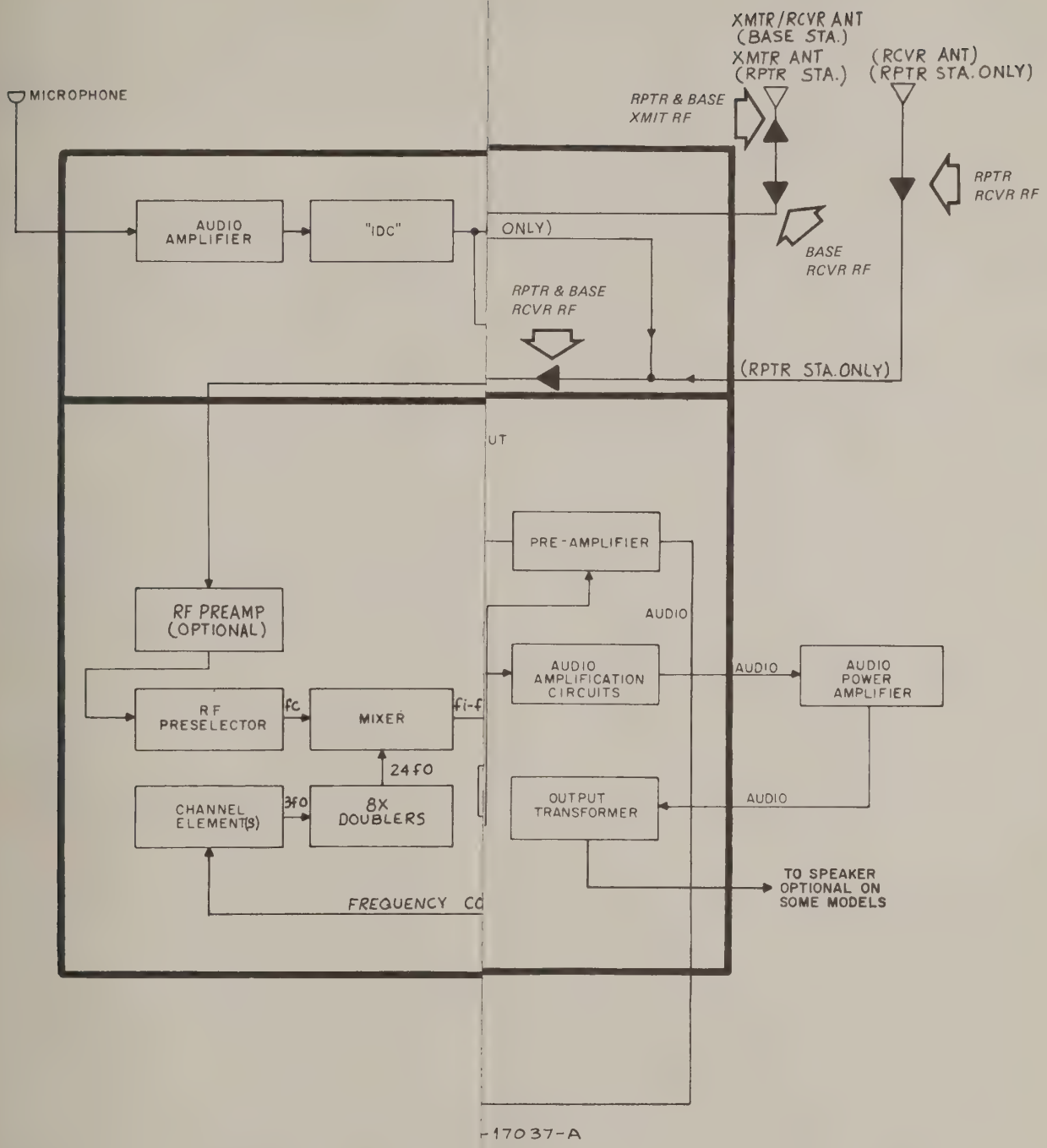
4. RECEIVER

4.1 The receiver accepts rf carrier signals on a specific channel in the 406-512 MHz range and provides voice audio in the 300-3000 Hz range. Refer to the station block diagram for functional operation. The receiver consists of the following items:

--Channel Element - A plug-in crystal oscillator module (channel element) provides stable frequency control for each frequency of operation. One channel element is required for each receiver frequency.

--Receiver RF & IF Board - The single-conversion superheterodyne FM receiver includes a preselector (comprised of six cavities) and two crystal filters for excellent selectivity. Two integrated circuit i-f amplifiers and limiters give high sensitivity. A crystal discriminator demodulates the audio directly from an 11.7 MHz i-f signal. (Some 2-receiver stations may have a "shifted i-f" to 11.8 MHz when required.) An AFC voltage is derived from the discriminator circuit which is used to correct the channel element frequency to provide an overall receiver stability of ±0.0002%.

--Audio & Squelch and Audio Power Amplifier Boards - Up to 10 watts of audio power at less than 5% distortion is provided by this circuit. When no messages are being received, the squelch circuit turns off the audio amplifiers to eliminate annoying noise in the speaker. A squelch tail eliminator circuit prevents the noise burst at the end of a message for strong signals. For weak signals, the circuit is automatically inhibited to prevent loss of portions of messages. The audio power amplifier transistors are mounted on a separate circuit board and aluminum heat sink for good heat dissipation.


XMTR/RCVR ANT
(BASE STA.)
XMTR ANT
(RPTR STA.)
(RCVR ANT)
(RPTR STA. ONLY)
MICROPHONE
RPTR & BASE
XMIT RF
RPTR
RCVR RF
AUDIO
AMPLIFIER
"IDC"
ONLY)
BASE
RCVR RF
RPTR & BASE
RCVR RF
(RPTR STA. ONLY)
PRE-AMPLIFIER
RF PREAMP
(OPTIONAL)
AUDIO
AUDIO
AMPLIFICATION
CIRCUITS
AUDIO
AUDIO
POWER
AMPLIFIER
RF
PRESELECTOR
fc
MIXER
24fo
CHANNEL
ELEMENT(S)
3fo
8X
DOUBLERS
OUTPUT
TRANSFORMER
AUDIO
TO SPEAKER
OPTIONAL ON
SOME MODELS
FREQUENCY

-17037-A

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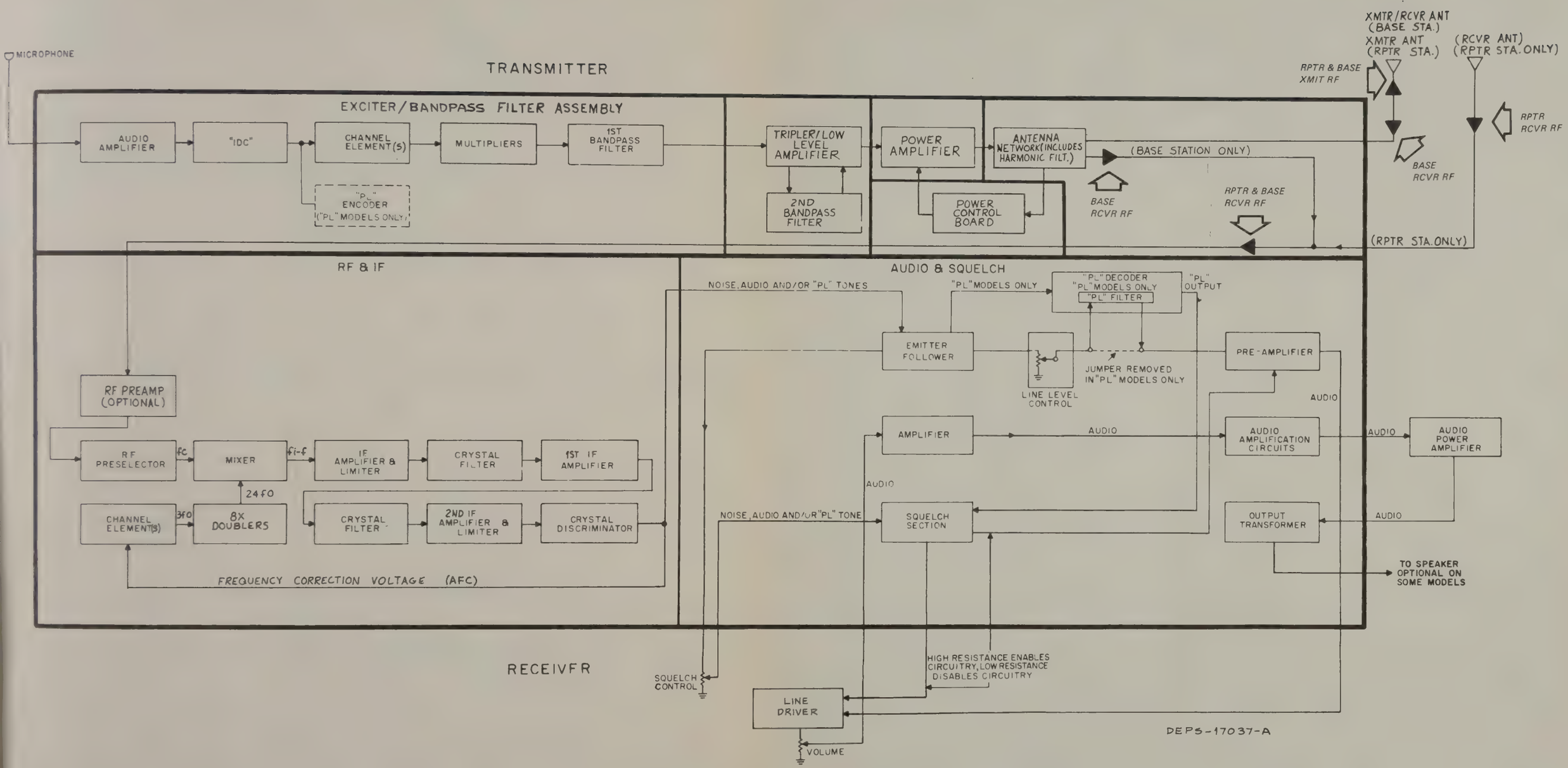
MICROPHONE
TRANSMITTER
EXCITER/BANDPASS FILTER ASSEMBLY
AUDIO AMPLIFIER
"IDC"
CHANNEL ELEMENT(S)
MULTIPLIERS
1ST BANDPASS FILTER
"PL" ENCODER ("PL" MODELS ONLY)
TRIPLER/LOW LEVEL AMPLIFIER
2ND BANDPASS FILTER
POWER AMPLIFIER
POWER CONTROL BOARD
ANTENNA NETWORK(INCLUDES HARMONIC FILT.)
(BASE STATION ONLY)
BASE RCVR RF
RPTR & BASE RCVR RF
XMTR/RCVR ANT (BASE STA.)
XMTR ANT (RPTR STA.)
(RCVR ANT) (RPTR STA. ONLY)
RPTR & BASE XMIT RF
RPTR RCVR RF
BASE RCVR RF
(RPTR STA. ONLY)
RF & IF
RF PREAMP (OPTIONAL)
RF PRESELECTOR
fc
MIXER
fi-f
IF AMPLIFIER & LIMITER
CRYSTAL FILTER
1ST IF AMPLIFIER
24fo
CHANNEL ELEMENT(S)
3fo
8X DOUBLERS
CRYSTAL FILTER
2ND IF AMPLIFIER & LIMITER
CRYSTAL DISCRIMINATOR
FREQUENCY CORRECTION VOLTAGE (AFC)
AUDIO & SQUELCH
NOISE, AUDIO AND/OR "PL" TONES
"PL" MODELS ONLY
"PL" DECODER "PL" MODELS ONLY
"PL" FILTER
"PL" OUTPUT
EMITTER FOLLOWER
LINE LEVEL CONTROL
JUMPER REMOVED IN "PL" MODELS ONLY
PRE-AMPLIFIER
AUDIO
AMPLIFIER
AUDIO
AUDIO AMPLIFICATION CIRCUITS
AUDIO
AUDIO POWER AMPLIFIER
AUDIO
NOISE, AUDIO AND/OR "PL" TONE
SQUELCH SECTION
OUTPUT TRANSFORMER
AUDIO
TO SPEAKER OPTIONAL ON SOME MODELS
HIGH RESISTANCE ENABLES CIRCUITRY, LOW RESISTANCE DISABLES CIRCUITRY
SQUELCH CONTROL
LINE DRIVER
VOLUME
RECEIVER
DEPS-17037-A

4.2 With 2-receiver stations, a 2-receiver coupler is used. This unit permits two receivers to operate from the same antenna. The coupler has a maximum insertion loss of 4 dB to each receiver.

4.3 An optional receiver rf preamplifier is also available to improve receiver sensitivity (SINAD) by 6 dB to .175 microvolt. When used with 2-receiver stations, this more than makes up for the half power loss in each "leg" of the 2-receiver coupler.

5. POWER SUPPLY

The power supply utilizes a ferro-resonant (constant voltage) transformer and provides all the voltages necessary for operating the station. It automatically corrects for changes in load and input voltage thus maintaining a constant voltage output.

6. VOLUME AND SQUELCH CONTROLS

Receiver VOLUME and SQUELCH controls are located on the receiver chassis (all other operational circuit and their controls are on plug-in modules inserted into the unified control chassis). The RECEIVER VOLUME control only affects local speaker operation (when used).

NOTE

The SQUELCH control affects local and remote operation.

7. "PRIVATE-LINE" TONE-CODED SQUELCH OPERATION

7.1 This type of operation permits private communications on crowded radio communication channels. Several "Private-Line" (PL) networks can use the same rf carrier frequency in the same area if each network uses a different PL tone frequency. The PL tones are in the 67-210 Hz range, which is below the 300-3000 Hz voice frequency range used in radio communication equipment.

7.2 The transmitters are modulated by a continuous sub-audible PL tone in addition to the voice modulation. The tone is generated by a PL encoder, which is a plug-in circuit board in the transmitter. The receivers accept only signals that are modulated with the specific PL tone frequency. Signals without the tone or with a different tone are not heard. Thus, only messages from your own PL network are heard. A PL decoder, which is also a plug-in circuit board in the receiver, disables the audio circuits of the receiver until the proper tone is received. A filter blocks the tone from the speaker so that it will not be heard.

7.3 In PL radio systems, the operator will not hear all on-frequency signals until he PL disables the receiver. The PL decoder is bypassed and the receiver reverts to carrier noise type squelch control. It is necessary to monitor the channel before transmitting to avoid interfering with other users.

NOTE

The Motorola Systems Engineering Department assigns the PL tone frequencies to prevent duplicate or interfering tones from being used in the same area. Consult them before changing tones or adding new ones.

8. "DIGITAL PRIVATE-LINE" BINARY-CODED SQUELCH OPERATION

This type of operation is similar to "Private-Line" tone-coded squelch operation but with greatly expanded code capability. Refer to separate Instruction Section 68P81106E83 for complete details.

9. ACCESSORIES

In addition to the base and repeater stations described in this manual, some additional items are needed to complete the installation as follows:

9.1 ANTENNA AND TRANSMISSION LINE

An antenna and transmission line kit is available from Motorola on separate order. The type used should be determined by a qualified radio communications engineer and will depend upon local operating conditions.

9.2 REMOTE CONTROL CONSOLE

A remote control console is required at the control location for this station. It must be compatible with the station; that is, it must supply the audio and control commands of the type that will be accepted by the station.

9.3 OPTIONAL ACCESSORIES

Many optional accessories are available as factory installed items in new stations, and as "add-to" items for field installation. Many of those optional accessories are described in this manual. Other accessories may become available after the printing of this manual. Also, other accessories are available which have more special application than those listed herein. See your local Motorola representative and the following Factory-Installed Options list for complete details.

TAB 1. DESCRIPTION

TAB 2. INSTALLATION

TAB 3. STATION MAINT
POWER SUPPLY

STATION MAINTENANCE
MAINTENANCE LOG SHEET
METERING & INTERCOM
POWER SUPPLY

TAB 4. TRANSMITTER

ALIGNMENT
MAINTENANCE
INTERCONNECT BOARD
EXCITER/1ST BANDPASS FILTER
POWER AMPLIFIERS
POWER CONTROL BOARD/
ANTENNA NETWORK/CONTROL STAGE
"PRIVATE–LINE" ENCODERS

TAB 5. RECEIVER

ALIGNMENT
MAINTENANCE
INTERCONNECT BOARD
RF & IF
AUDIO & SQUELCH
"PRIVATE–LINE" DECODERS

INSTALLATION

IMPORTANT

FCC regulations state that:

1. Radio transmitters may be tuned or adjusted only by persons holding a 1st or 2nd class commercial radiotelephone operator's license or by personnel working under their immediate supervision.

2. The rf power output of a radio transmitter shall be no more than that required for satisfactory technical operation considering the area to be covered and local conditions.

3. Frequency, deviation and power of a base station transmitter must be checked before it is placed in service and rechecked every year thereafter.

REMEMBER

The efficiency of the equipment depends upon a good installation.

1. INSPECTION

Inspect the equipment thoroughly as soon as possible after delivery. If any part of the equipment has been damaged in transit, report the extent of damage to the transportation company immediately.

2. PLANNING THE INSTALLATION

Since a good installation is so important to obtain the best possible performance of the communications system, carefully plan the installation before actual work is started. Location of the station in relation to power, control lines, the antenna, convenience and access for servicing should be considered. The cabinet dimensional detail diagrams show the size of the various cabinets for planning the space requirements. Read the entire procedure and the many suggestions offered to help you plan your installation. Make sure all tools, equipment and facilities are available when the installation is begun.

3. VENTILATION

The radio equipment is operated without forced ventilation. The cabinets have vents which allow outside air to be drawn in through an opening in the bottom of the doors and expelled through an opening in the top of the doors. The heated air rising in the cabinet causes a natural draft. Therefore, it is essential that the openings be kept free of obstructions so the air flow will not be restricted. The vents on outdoor type cabinets provide necessary station ventilation and in addition prevent rain, snow, etc. from entering the cabinet.

4. INSTALLATION OF 30-, 41-, AND 60-INCH INDOOR "COMPA-STATION" CABINETS

4.1 Refer to cabinet drawings at the end of this section for cabinet dimensional details.

4.2 The cabinet should be located on a solid, level surface convenient to the power

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source and the transmission line. The transmission line should be kept as short as possible to minimize line losses.

4.3 All antenna, power and control lines may be brought through the notch at the bottom of the rear door. Any or all of these lines may be brought out through the bottom, side or top of the cabinet, if desired, by drilling a hole in the cabinet at the desired position.

CAUTION

Before drilling, check location of proposed hole and verify that equipment will not be damaged by the drilling.

5. INSTALLATION OF 70-INCH INDOOR UPRIGHT STATION CABINET

5.1 GENERAL

Refer to cabinet drawings at the end of this section for the cabinet dimensional detail. The cabinet should be located on a solid, level surface convenient to the power source and the transmission line. The transmission line should be kept as short as possible to minimize line loss.

5.1 REMOVAL AND REVERSING OF DOORS

Both front and rear doors are removable by simply unhooking the arm of the door stop from the door and pulling down on the upper hinge pin. If desired, both front and rear doors may be reversed from right hand opening to left hand opening as follows:

Step 1. Remove the door and unbolt the hinge brackets from the cabinet.

Step 2. Remount these hinge brackets on the opposite side of the cabinet.

Step 3. Turn the door upside down and reinsert the hinge pins in the brackets.

Step 4. Remove the latch bar from the rear of the door lock and reinstall it 180° from its original position.

5.3 REMOVAL OF SIDE PANELS

The sides of the cabinet may be easily removed to aid in the installation or maintenance of the unit. Proceed as follows:

Step 1. Using a nut driver tool, remove the sheet metal screw located in the middle or the lower edge of the side panel, as viewed from inside the cabinet.

Step 2. Insert a large screwdriver between the lower edge of the side panel and the bright trim strip on the outside of the cabinet and pry up slightly to release the friction grips.

Step 3. Grasp the side panel at the edges with both hands and lift up several inches to remove it.

5.4 REPLACEMENT OF SIDE PANELS

Step 1. When replacing the side panel, position it over the frame with the top several inches above the top of the cabinet.

Step 2. Slowly slide the side panel down into position. When the top of the side panel is flush with the top of the cabinet, the panel is positioned properly.

Step 3. The locking screw should be replaced for security reasons.

6. INSTALLATION OF 46- AND 75-INCH "OUTDOOR" CABINETS

6.1 GENERAL

6.1.1 Refer to cabinet drawings at the end of this section for cabinet dimensional details.

6.1.2 The outdoor station may be installed in any convenient location (indoors or outdoors) which provides space to open the front and rear doors. If it is installed outdoors, the rain shield kit (which is packed with the cabinet) should be installed as described in this section. With these installed, the station is protected against all normally encountered elements such as rain, snow or sleet.

6.1.3 The station is not intended to withstand submersion in water. If pools of water could gather around the cabinet base, it is recommended that the cabinet be elevated on a suitable supporter platform.

6.1.4 Although the cabinet is built to be installed outdoors, it should be realized that maintenance of the station is not easily

accomplished in inclement weather. It is therefore recommended that the station be installed inside of an enclosure which would provide protection for the serviceman and the test equipment he may be using. One such enclosure would be an elevator penthouse or a small building no less than six feet square and eight feet tall as measured on the inside.

6.1.5 The cabinet should be located on a solid, level surface convenient to the power source and the transmission line. The transmission line should be kept as short as possible to minimize line losses.

6.2 46-INCH CABINET RAIN SHIELD INSTALLATION

6.2.1 General

The rain shield kit is provided to cover the air vent openings at the top and bottom of both cabinet doors.

6.2.2 Procedure

The complete rain shield installation procedure is given in step form on the 46-inch outdoor cabinet dimensional detail at the end of this section.

6.3 75-INCH CABINET RAIN HOOD AND VENT SHIELD INSTALLATION

6.3.1 General

The rain hood is provided to cover the air vent in the top of the cabinet and the vent shield to cover the opening in the rear door.

6.3.2 Installation of Rain Hood

Step 1. Install the main section (largest fabricated assembly) over the opening in the top of the cabinet using the rectangular shaped gasket and 1/2-inch sheet metal screws provided.

Step 2. Mount the small rectangular cover inside the main section using the machine screws provided.

Step 3. Similarly, mount the larger cover on top of the whole assembly.

6.3.3 Installation of Vent Shield

Mount the awning-shaped vent shield over the opening in the rear door using the "U" shaped gasket and 3/8-inch sheet metal screws. Place the acorn nuts over the screws to cover exposed threads.

7. ANTENNA CONNECTIONS

7.1 INTRODUCTION

7.1.1 The antennas and transmission lines are not part of the station. Therefore, antenna installation instructions are not included in this section. Follow the instructions shipped with the antennas for applicable information.

7.1.2 In its primary application, the station is used for communications with mobile radios. Thus antennas having omni-directional characteristics are desirable. However, if the station is located at the outer perimeter of a communications area, or if it is to be used for communications with fixed stations, antennas with specific directional characteristics may be more suitable. FCC requirements may also dictate the type of antenna to be used.

7.1.3 For base stations, the antenna's coaxial cable connects to the antenna network output with a type N connector. For repeater stations without an optional duplexer, two antennas are required, one for the transmitter and one for the receiver. The antenna coaxial cables connect directly to the transmitter and receiver. The transmitter output requires a type N connector at the antenna network output--the receiver input requires a type BNC connector. For repeater stations with an optional factory installed duplexer, the antenna's coaxial cable connects to the duplexer with a type UHF connector. (Refer to Figure 1.)

7.2 31-, 41-, AND 60-INCH INDOOR CABINET ANTENNA CABLE ROUTING AND CONNECTION

Step 1. The antenna coaxial cable(s) may be brought through the notch at the bottom of the

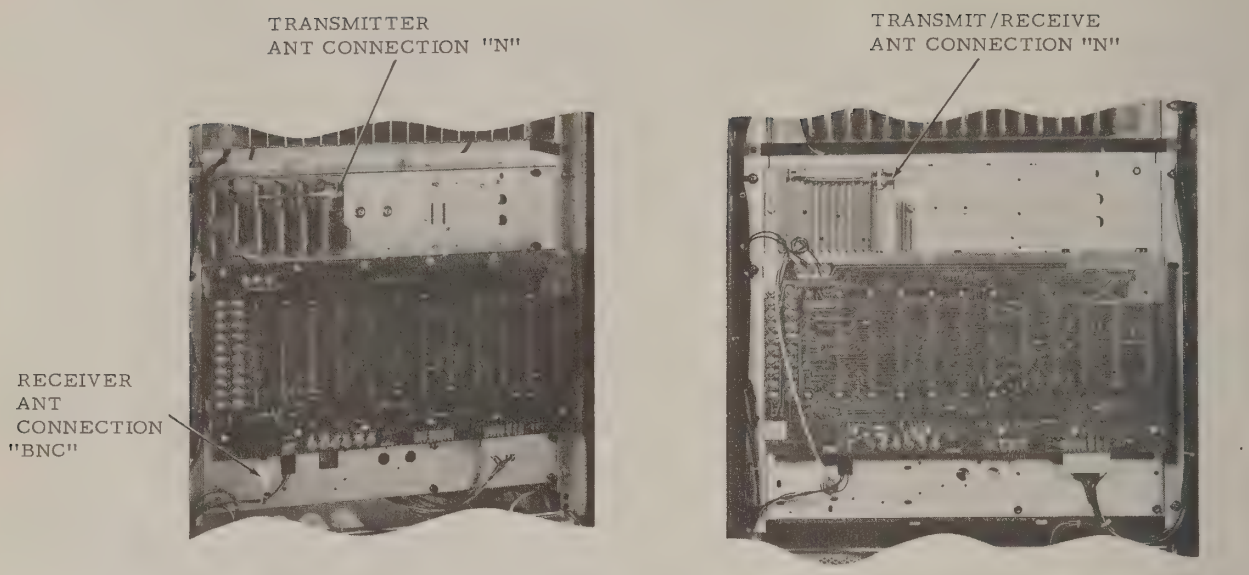


Figure 1.
Antenna Connection Locations

rear door. Cable(s) may be brought out through the bottom, side or top of the cabinet, if desired, by drilling a hole in the cabinet at the desired position.

CAUTION

Be careful to determine internal clearance before drilling access holes. A 3/4-inch diameter hole allows conduit to be installed for cable runs. If conduit is not used, install rubber grommets in the holes to protect the cable(s).

Step 2. Connect the antenna cable(s) as shown in Figure 1 and discussed in paragraph 7.1.3.

7.3 46-INCH OUTDOOR CABINET ANTENNA CABLE ROUTING AND CONNECTION

This outdoor cabinet antenna cable routing and connection procedure is the same as described for indoor type cabinets except the entrance must be sealed and made as weatherproof as possible.

7.4 70-INCH INDOOR CABINET ANTENNA CABLE ROUTING AND CONNECTION

7.4.1 General

Six knockouts in three sizes are provided on the cabinet top for ease of installation. Refer to Figure 2 Cabinet Knockout Detail for proper hole usage and to Figure 3 Indoor Cabinet Antenna Cable Installation Diagram for typical installation details. Determine the type of cable entry or entries required as described in paragraph 7.1.3 and select the most convenient knockout(s). The coaxial output lead must be kept as short as possible to keep power loss to a minimum.

7.4.2 Transmission Lines Terminated in Female Connector

Step 1. Secure the transmission line (through the appropriate knockout) directly to the cabinet top with the nut supplied.

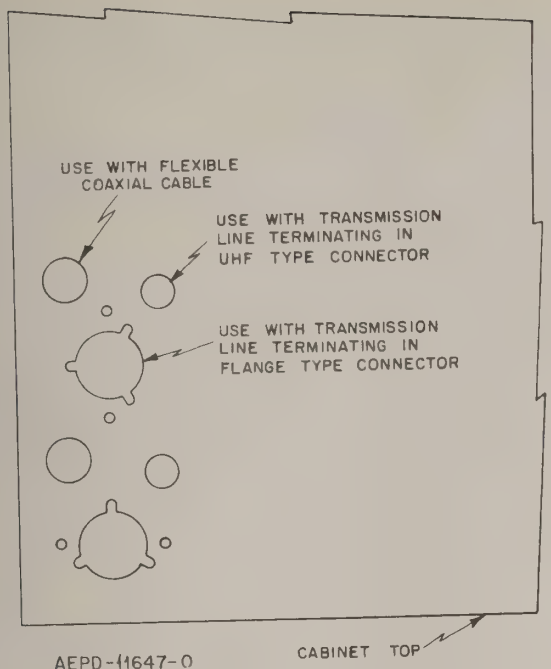

USE WITH FLEXIBLE COAXIAL CABLE
USE WITH TRANSMISSION LINE TERMINATING IN UHF TYPE CONNECTOR
USE WITH TRANSMISSION LINE TERMINATING IN FLANGE TYPE CONNECTOR
CABINET TOP
AEPD-11647-0

Figure 2.
Cabinet Knockout Detail

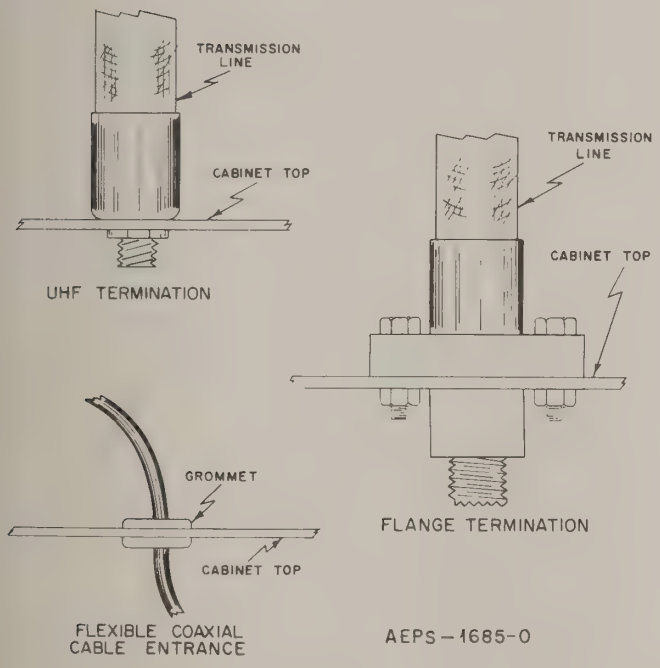


Figure 3.
Indoor Cabinet Antenna Cable Installation

Step 2. Measure and cut a piece of coaxial cable so that it will reach between the station output connector and the transmission line connector in the cabinet top.

Step 3. Install connectors as required.

7.4.3 Transmission Lines Terminated in Flange Type Connector

Step 1. Install the flange type connector in the cabinet top using the appropriate knockout.

Step 2. Measure and cut a piece of coaxial cable so that it will reach between the station output connector and the flange type connector in the cabinet top without any sharp bends.

Step 3. Install connectors as required.

7.4.4 Externally Terminated Transmission Line

The transmission line may be terminated adjacent to the cabinet, but must be within reach of the coaxial cable that connects to the radio equipment.

Step 1. Punch out the 7/8-inch knockout in the cabinet top.

Step 2. Install the rubber grommet (supplied) in the hole.

Step 3. Install a coaxial jumper cable of sufficient length to provide proper connection.

7.5 75-INCH OUTDOOR CABINET ANTENNA CABLE ROUTING AND CONNECTION

Step 1. A flange-type bulkhead fitting should be used to make a weatherproof entry for the antenna transmission line(s). The recommended location for the fitting is on the right side of the cabinet (as viewed from the front) with its center 21 inches from the top and 7 inches from the rear. Any alternate location must be selected with caution to insure that the area is clear of chassis, framework, etc.

Step 2. Install connectors as required.

8. AC INPUT POWER CONNECTIONS

8.1 INTRODUCTION

8.1.1 All stations should have a separate power circuit from a 10-ampere (minimum), 120-volt ac, 60 Hz power source. The power lines should be installed in accordance with local electrical codes.

8.1.2 The primary ac power line may be installed prior to installation of the

cabinet and terminated near the location chosen for the station.

8.2 31-, 41-, 60-INCH INDOOR/46-INCH OUTDOOR CABINETS POWER CONNECTION

8.2.1 Indoor and outdoor power connections are identical except that outdoor station requires additional weatherproofing.

WARNING

If a three wire grounded primary ac power source is not available the radio equipment must be grounded separately to prevent electrical shock hazards and provide lightning protection.

8.2.2 Connect the three-wire ac line cord to the ac outlet. A power on-off switch is not provided in the equipment, therefore, with power applied, the equipment is in an operative condition.

8.2.3 The station fuse controls all power to the station except ac power to the outlet in the power supply.

8.3 70-INCH INDOOR CABINET POWER CONNECTION

8.3.1 If the station is located in a room with a utility trough in the floor, the station may be installed over the trough and the power and control leads brought up through the bottom of the cabinet into the station. Do not punch out the knockouts for such an installation.

8.3.2 Two knockouts are also provided on the rear panel of the cabinet base for rear entrance of the power and control lines. When facing the rear of the cabinet, the right hand knockout is intended for the entrance of ac power. Punch out the knockout. Install a 7/8-inch rubber grommet (supplied) in the hole to protect the cable.

8.4 75-INCH OUTDOOR CABINET POWER CONNECTIONS

8.4.1 For bottom cable entry, power and control cables may be brought in at almost any desired point through the bottom of the cabinet. Measure and center punch the desired cable entry locations. Using the center punch marks as the center of the holes, drill 3/4-inch holes with a hold saw. Install rubber grommets in the holes to protect the cables. Seal the entry to make the opening as weatherproof as possible.

8.4.2 For rear cable entry, two punch marks are located on the rear panel of the cabinet base. Using these as centers, drill holes in the cabinet with a 3/4-inch hole saw. When facing the rear, the right-hand hole is intended for the entrance of ac power and the left-hand hole is intended for the entrance of control lines. Install rubber grommets in the holes to protect the cables. Seal the entry to make the opening as weatherproof as possible.

9. OPTIONAL MODE JUMPERING

9.1 GENERAL

9.1.1 Many station modes of operation are determined by jumper connections at the time of installation and are described in the following paragraphs.

9.1.2 Additional jumpers used with the station are identified and described in applicable sections elsewhere within this instruction manual.

9.2 TIME-OUT TIMER MODULE

Base stations or repeaters equipped with a time-out-timer module prevent unintentional continuous transmission. The timing jumpers on the module may be connected for 1/2, 1, 2, 4 or 8 minute operation. In repeaters, the time-out-timer will reset each time a new input signal arrives at the station, whether or not the drop-out delay generator has shut off the transmitter. Repeater time-out time and line transmit time periods may be selected independently with the repeater select jumper and the line select jumper.

9.3 SQUELCH GATE

In repeater stations, the dropout delay generator in the squelch gate module prevents the transmitter from shutting off during loss or excessive fade of input signal for the length of time preset. The jumper can be set for 0, 1, 2, 4 or 8 second operation.

9.4 TWO-RECEIVER STATIONS

9.4.1 Stations equipped with two receivers can be connected for receiver #1 priority or receiver #2 priority if desired. A

signal received on the priority receiver automatically mutes the other receiver. These jumpers are located on the line driver module.

Receiver #1 priority - JU18 OUT
JU24 IN
Receiver #2 priority - JU18 IN
JU24 OUT

9.4.2 Jumpers in the line driver module also allow receiver #2 to be partially muted (audio attenuation) if desired, rather than the full muting as shipped from the factory. Attenuation of 10 dB, 20 dB or 30 dB in respect to the unmuted condition are possible by jumper connections as follows.

30 dB attenuation - JU25, 26 IN
JU27 OUT
20 dB attenuation - JU25 IN
JU26, 27 OUT
10 dB attenuation - JU25, 26 & 27 OUT

9.4.3 Receiver #2 mute attenuation is a standard feature of dc controlled stations and optional on tone control.

10. CONTROL LINE CONNECTIONS

10.1 INTRODUCTION

10.1.1 The station can be controlled from a remote point over wire line circuits. Simplex audio is used, meaning that the remote point can send audio to the station or receive audio from the station, but not both at the same time. Therefore, a single audio pair will suffice. For dc remote control operation, the wire line must provide dc continuity for carrying the dc control currents. This must be the same pair that carries the transmit audio. For tone remote control operation the audio pair also carries the audio control tones.

10.1.2 Four-wire audio operation, wherein transmitter audio and receiver audio are carried on separate wire pairs, is possible with the optional Line Driver/4-wire, 2-receiver Audio Module (this module is also used in 4-wire, single receiver application). In such operation, line 1 is the transmit pair and line 2 is the receive pair.

10.1.3 In stations with two receivers and four-wire audio, jumpers can be arranged to use line 2 to carry the audio from receiver #2 only if desired.

10.2 LINE SPECIFICATIONS

The audio wire line(s) must meet the following specifications for acceptable radio communications. Verify the characteristics of leased telephone lines with the company providing the service before installation.

10.2.1 DC Remote Control Operation

AUDIO LINE REQUIREMENTS
1. FREQUENCY RESPONSE:
500 TO 2500 Hz
2. IMPEDANCE:
600-OHM BALANCED LINE

DC LINE REQUIREMENTS
1. DC RESISTANCE 0 TO 8000 OHMS.
2. MUST HAVE DC CONTINUITY.

10.2.2 Tone Remote Control Operation

FREQUENCY RESPONSE: 500 to 2500 Hz
FREQUENCY TRANSLATION ERROR:
±10 Hz MAX.
IMPEDANCE: 600-OHM BALANCED LINE
SIGNAL-TO-NOISE: 35 dB MIN.

Chart of Maximum Input and Loss

PHONE-COMPANY SPECIFIED MAXIMUM INPUT	MAXIMUM PHONE LINE LOSS USABLE WITH REMOTELY-CONTROLLED RADIO
+8 vu (14 dBm)	32 dB
0 vu (6 dBm)	24 dB
-8 vu (-2 dBm)	16 dB

10.3 INSTALLATION

10.3.1 General

The control line may be installed prior to installation of the cabinet and terminated near the location chosen for the station. Conduit or two-wire cable can be used from this termination to the station cabinet.

10.3.2 Specific Connection Information

Connect the 600-ohm lines to the screw terminals on the rear of the unified chassis

interconnect board as shown in Figure 4. (In 2-wire applications, use line 1 connections.)

10.3.3 DC Control Line Levels

When the dc control line is initially connected, it must be tested to assure that its loop resistance is low enough to allow sufficient current for remote operation. Use the following test procedure.

Step 1. Connect a dc milliameter in series with the dc control line.

Step 2. Have the operator press the push-to-talk switch at the remote control console.

Step 3. The current must be at least +5.5 mA to key the transmitter and at least +10 mA for two-frequency transmitters. Check to see that the current is positive and not negative and that the station is actually keyed. Adjust the remote control console for F1 line current until +5.5 mA is achieved. For a two-frequency transmitter, adjust the remote control console for F2 line current of 10 to 12 mA.

If the line loop resistance is too high, the maximum line current from the console will not key the transmitter. There are two alternatives to correct this problem.

--Use a pair of lines having lower resistance while maintaining proper audio response, or

--Use an alternate pair of lines with lower resistance to carry dc current only. This pair need not have good audio loss or response characteristics.

Adjust the line current for "Private-Line" disable at the remote control console for -2.5 mA, if a "Private-Line" model is being adjusted.

10.3.4 Tone Control Line Levels

The control tone levels for the remotely controlled functions are adjusted at the remote control console. No additional adjustments are required.

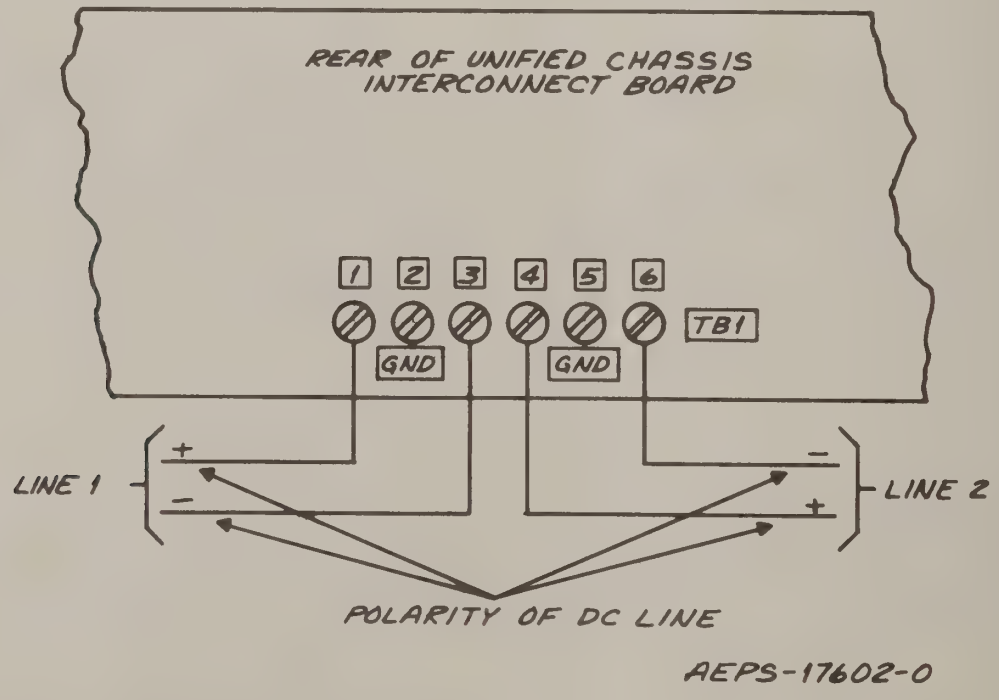


Figure 4.
Control Line Connections

11. CONTROL LINE LEVEL ADJUSTMENT

11.1 GENERAL INFORMATION

11.1.1 Most telephone companies limit the maximum signal amplitude which they will allow on their lines. The most common maximum level is 0 vu (volume units); check the telephone company for the maximum level to be used on your lines. Adjust the audio levels to the maximum permissible level which will give the best signal-to-noise ratio. For lines not subject to telephone company restrictions adjust speech levels to +8 vu.

11.1.2 The vu is the measurement for speech and can be measured only with a vu meter. This meter has special ballistics to control the rise and fall time and the overshoot of speech signal voltage. Since speech signals fluctuate so rapidly, special metering techniques are required. The meter point of a vu meter responds is a series of "kicks" or deflections of varying amplitude. Over a period of time, a majority of peaks will reach approximately the same level. There will be a few very strong peaks which will exceed this level and a few peaks of lower level. These are ignored and the measured speech level equals the majority of the "kicks" or peaks reached. Measurements show that the instantaneous peaks of a speech signal are about 10 dB higher than the vu value (the instantaneous peaks of a 0 vu speech signal will equal the peaks of a sine wave signal of ±10 dBm magnitude). Of course, a sine wave signal of ±10 dBm would produce a much greater volume because every cycle of the signal goes to peak amplitude.

11.1.3 Adjustment of the audio line levels is very difficult using actual speech signals which fluctuate so greatly. A sine wave signal (1000 Hz continuous tone, for example) is much easier to use for adjustments. However, sine wave signals are measured in dBm and the telephone company specifies the maximum signal level in vu. THERE IS NO CONVERSION FROM VU TO DBM OR VICE VERSA when measuring speech. Speech cannot be measured in dBm or converted into dBm. The dBm is a unit to measure the sine wave power as referenced to 1 milliwatt of power. The power of a speech signal of a particular vu is not defined and is different for different speakers. IT IS POSSIBLE TO CALIBRATE A VU METER BY USING A SINE WAVE SIGNAL ON THE 600-OHM LINE, THEN MEASURING THE SAME SIGNAL IN DBM WITH A VOLTMETER. On a 600-ohm line, a sine wave signal that will produce a 0 vu reading will measure 0 dBm on a voltmeter. This does not mean that 0 vu is equal to 0 dBm. Remember, the peaks of an actual 0 vu speech signal will have instantaneous peaks of +10 dBm amplitude.

11.1.4 We would normally conclude that sine wave signal levels would be adjusted 10 dB higher than the vu level specified for the line. EXPERIMENTAL MEASUREMENTS HAVE PROVEN THAT SINE WAVE SIGNAL LINE LEVELS SHOULD BE 6 DB HIGHER THAN THE VU LEVEL SPECIFIED FOR THE LINE (+8 vu speech level should be adjusted for +14 dBm tone level; 0 vu speech level should be adjusted for +6 dBm tone level).

600-OHM LINE VU, DBM, AND VOLTAGE EQUIVALENCY CHART

If Maximum Speech Level For Line Is	Adjust Tone Line Level For (1 mW ref)	Voltage Equivalent
+14 vu	+20 dBm	7.74 V
+12 vu	+18 dBm	6.15 V
+10 vu	+16 dBm	4.88 V
+8 vu	+14 dBm	3.88 V
+6 vu	+12 dBm	3.08 V
+4 vu	+10 dBm	2.44 V
+2 vu	+8 dBm	1.94 V
0 vu	+6 dBm	1.54 V
-2 vu	+4 dBm	1.22 V
-4 vu	+2 dBm	0.97 V
-6 vu	0 dBm	0.77 V
-8 vu	-2 dBm	0.61 V
-10 vu	-4 dBm	0.48 V
-12 vu	-6 dBm	0.38 V
-14 vu	-8 dBm	0.30 V
-16 vu	-10 dBm	0.24 V
-18 vu	-12 dBm	0.19 V
-20 vu	-14 dBm	0.15 V
-22 vu	-16 dBm	0.12 V
-24 vu	-18 dBm	0.09 V
-26 vu	-20 dBm	0.07 V

11.2.1 General

11.2.1.1 A local speaker at the station may be used for testing and level settings. If the station is equipped with built-in metering, it includes a local speaker. If not, the speaker in a Motorola portable test set may be used by connecting the test set with "Micor" adapter to the control receptacle (J3) on the unified chassis interconnect board. Otherwise, a "Micor" mobile speaker can be connected to the local speaker pins (J4-1 and -12 of unified

chassis interconnect board). The receiver VOLUME control sets the audio level at the local speaker only.

11.2.1.2 Exciter audio should be measured at the input to the exciter and adjusted for the sensitivity value stamped on the exciter. This level should be measured at pins 12 and 19 of Exciter Board Plug P902.

11.2.1.3 "Private-Line" receivers must be PL disabled during adjustments with the PL DISABLE switch on the station control module. In "Private-Line" repeaters, the squelch gate must also be set for carrier squelch operation during adjustments by connecting jumper JU14 to the active pin and JU15 to the dummy pin. Be sure to return the jumpers to the PL condition after adjustments are complete.

11.2.1.4 If the station is equipped with a single-tone decoder module for repeater access unplug the single-tone decoder during adjustments.

11.2.2 Repeater Level Setting

Step 1. Set the receiver SQUELCH control at squelch threshold.

Step 2. Inject an on-frequency carrier signal into the receiver antenna input. Adjust the signal level to 20 dB quieting.

Step 3. Adjust the REPEATER SQUELCH KEY control (squelch gate module) so the transmitter just keys.

Step 4. Modulate the receiver input with a 1000-Hz tone at ±5 kHz deviation. Adjust the REPEATER LEVEL control (squelch gate module) so the exciter audio input (measured at pins 12 and 19 of Exciter Board Plug P902) is the value stamped on the exciter (modulator sensitivity +6 dB or approximately ±5 kHz transmitter deviation).

Step 5. On "PL" repeaters, return jumpers JU14 and JU15 to the "PL" condition.

11.2.3 Wire Line Controlled Base Stations and Repeater Stations

11.2.3.1 Determine the maximum allowable audio level permitted on the lines (use +8 vu for non-regulated lines) and set line audio levels to this amplitude. Refer to the 600-OHM, VU, DBM AND VOLTAGE EQUIVALENCY CHART for tone levels to be used.

NOTE

The following procedures assume the +8 vu speech level (+14 dBm tone level). For other speech levels, use a tone level 6 dB higher than the vu level (for 0 vu use +6 dBm); refer to the equivalency chart. On some lines, tone levels are not permitted to exceed the speech levels, even for short test tones (for example, maximum speech level of 0 vu and maximum tone level of 0 dBm). When such regulations apply, use the special procedures for low level test tone.

11.2.3.2 As mentioned previously, the lines used to carry audio have an ac impedance of 600 ohms. The amplitude of signals is most conveniently measured in dBm. Zero dBm is equal to 1 milliwatt across 600 ohms. Most audio voltmeter, such as the Motorola Transistorized AC Voltmeter, are calibrated to read directly in dBm when measuring across a 600-ohm impedance. Never use a volt-ohm meter or a multimeter.

Step 1. Apply a 1000-Hz audio tone to the remote control console at a level sufficient to drive the amplifier into compression. Adjust the output of the remote control console for +14 dBm (or maximum allowable audio level) at its output terminals. If the level at the station is above 0 dBm, remove JU1 on the station control module.

Step 2. Adjust the XCTR LEVEL control (station control module) so the exciter audio input (measured at pins 12 and 19 of Exciter Board Plug P902) equals the value stamped on the exciter. (Modulator sensitivity plus 3 dB or approximately ±5 kHz transmitter deviation.)

Step 3. Remove the 1000 Hz audio tone.

Step 4. Set the receiver SQUELCH control for squelch threshold.

Step 5. Inject a 1000 uV carrier frequency signal into the antenna input of the receiver. Modulate the signal with a 1000-Hz tone at ±5 kHz deviation.

Step 6. Adjust the LINE 1 OUTPUT (line driver module) for +14 dBm (3.9 V) or maximum allowable audio level as measured with an audio voltmeter across the line 1 terminals. If four-wire audio operation is used, with the receiver output applied to line 2, adjust the LINE 2 OUTPUT control while measuring across the line 2 terminals.

Step 7. If the station has two receivers, both feeding to line 1, set the LINE 1 OUTPUT control as specified with a ±5 kHz modulated carrier signal injected into receiver 1. Next, inject a ±5 kHz modulated carrier into receiver 2. If the line output on the voltmeter changes by more than 2 dBm, readjust the potentiometer on the receiver 2 audio and squelch board to match the receiver 1 reading.

Step 8. If the station has two receivers, each on a different line, adjust LINE 1 OUTPUT with a modulated carrier injected into receiver 1, and adjust LINE 2 OUTPUT with a modulated carrier injected into receiver 2.

11.2.4 Special Procedure for Low Level Test Tone

NOTE

The following procedure is written for the 0 vu speech level and 0 dBm test tone level, but other levels may be used by substituting appropriate levels (levels across the 600-ohm load should be 6 dB higher than the specified line level).

Step 1. Terminate the remote control console in a 600-ohm load resistor rather than the line.

Step 2. Apply a 1000-Hz audio tone to the remote control console at a level sufficient to drive the amplifier into compression.

Step 3. Connect an audio voltmeter across the 600-ohm load resistor and adjust the line output for +6 dBm.

Step 4. Reduce the 1000 Hz audio tone input until the voltmeter reads 0 dBm.

Step 5. Remove the 600-ohm load resistor and reconnect the line. Readjust the line output for 0 dBm across the line. Do not change the 1000 Hz tone level.

Step 6. Connect the audio voltmeter to the exciter audio input at the station and adjust the XCTR LEVEL control for 6 dB less than the value stamped on the exciter.

Step 7. Disconnect the line at the station and connect a 600-ohm load resistor in its place.

Step 8. Apply a 1000 uV carrier signal to the receiver antenna terminal from an FM signal generator. Modulate the carrier signal with a 1000 Hz tone at ±5 kHz deviation.

Step 9. Connect an audio voltmeter across the 600-ohm load resistor and adjust the LINE 1 OUTPUT control for +6 dBm.

Step 10. Reduce the deviation until the voltmeter reads 0 dBm.

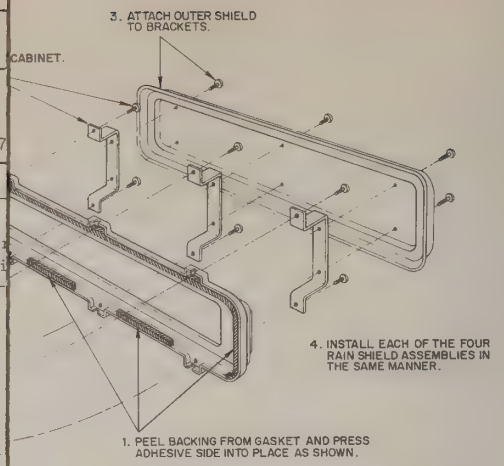
Step 11. Remove the 600-ohm load resistor and reconnect the line. Readjust the LINE 1 OUTPUT for 0 dBm as measured across the line.

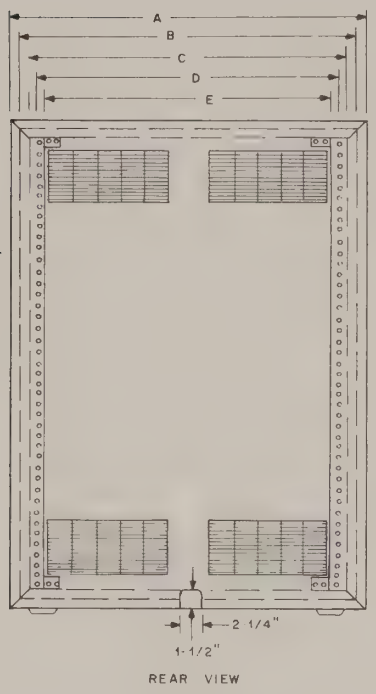
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

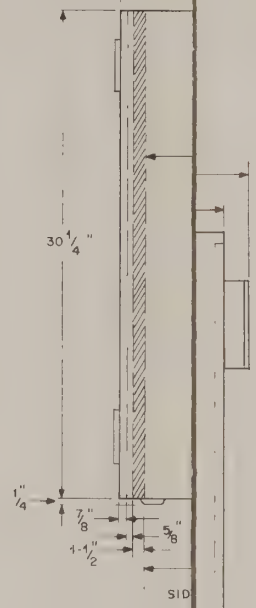
PARTS LIST

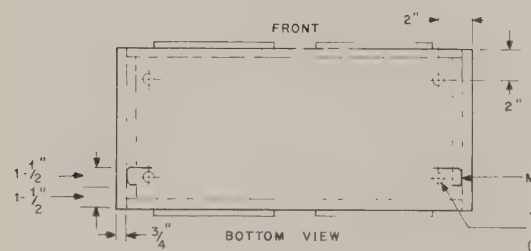
THN6141A Cabinet Kit (31-Inch) PL-17

NON-REFERENCED ITEMS		
	15E84107D01	CABINET (31")
	13C84430D01	DOOR VENT (8 requi
	2S10101A55	SPEED NUT (48 requi

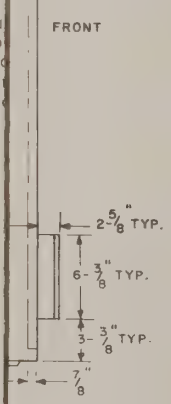

3. ATTACH OUTER SHIELD TO BRACKETS.
CABINET.
4. INSTALL EACH OF THE FOUR RAIN SHIELD ASSEMBLIES IN THE SAME MANNER.
1. PEEL BACKING FROM GASKET AND PRESS ADHESIVE SIDE INTO PLACE AS SHOWN.







A = 22" CABI
B = 20-1/2" D
C = 19-3/16"
D = 18-5/16"
E = 17-11/16



STATION HA

TRN6197A (1
TRN6198A (1
TRN6199A (H
TRN6200A (H

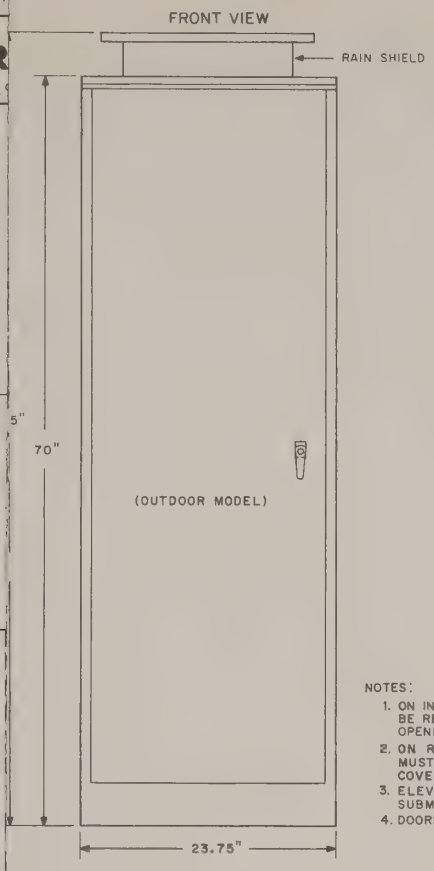
NG
TERS
TWEEN RAILS

STATION CABINETS

Station Cabinets
Dimensional Details and Parts Lists
Motorola No. PEPS-17767-B
(Sheet 1 of 2)
1/4/77-UP

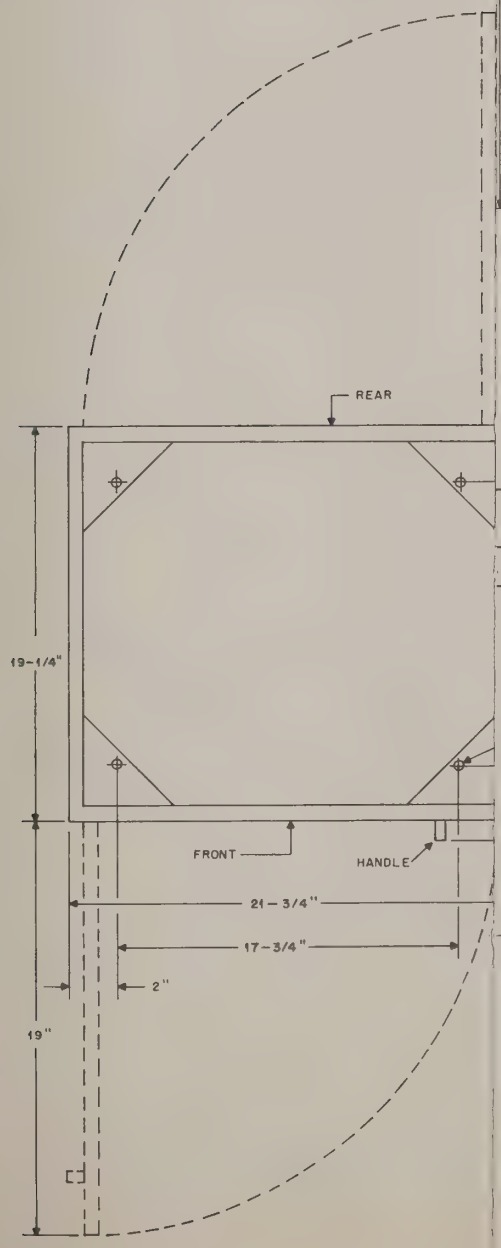
REFER
SYM

PAR
TRN61



NOTES:
1. ON INDOOR CABINETS, FRONT AND REAR DOORS CAN BE REVERSED FROM RIGHT OPENING TO LEFT HAND OPENING.
2. ON REAR DOOR, OPENING OPPOSITE AIR DUCT MUST BE UNCOVERED AND UNUSED OPENING COVERED (INDOOR CABINETS ONLY).
3. ELEVATE CABINET IF DANGER OF WATER SUBMERSION EXISTS.
4. DOORS ON OUTDOOR CABINETS ARE NOT REMOVABLE.

TOP VIEW
(VIEW WITH TOP OFF OF CABINET)



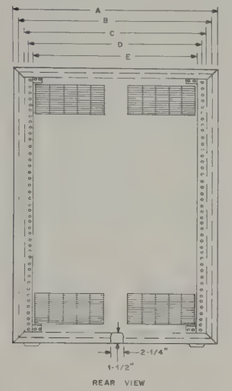
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
LN6892A Rain Shield Kit		PL-3402-O
	26-82929H01	SHIELD, rain (top)
	26-84084F01	SHIELD, cover (top)
	15-82926H01	COVER, rain shield
	26-82930H01	SHIELD, rain (door)
	32-82930H01	GASKET, rain shield
	32-82932H02	GASKET, rain shield
	32-84180G01	GASKET: 2 req'd.
	32-84180G02	GASKET: 2 req'd.
	2-10080A03	NUT, spring: No. 8; 4 req'd.
	3-9661	SCREW, machine: 8-32 x 3/8"; 8 req'd.
	3-132823	SCREW, tapping: 8-18 x 3/8"; 4 req'd.
	3-135014	SCREW, tapping: 8-18 x 1/2"; 6 req'd.

Station Cabinets
Dimensional Details and Parts Lists
Motorola No. PEPS-17767-B
(Sheet 2 of 2)
1/4/77-UP

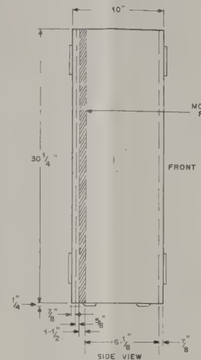
PARTS LIST

THN6141A Cabinet Kit (31-Inch) PL-1787-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
NON-REFERENCED ITEMS		
	15E84107D01	CABINET (31")
	13C84430D01	DOOR VENT (8 required)
	2S10101A55	SPEED NUT (48 required)



REAR VIEW



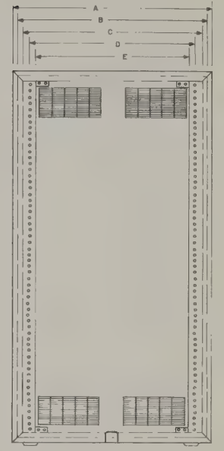
SIDE VIEW

BOTTOM VIEW

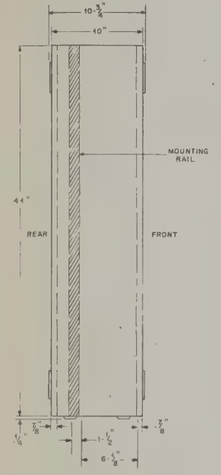
A = 22" CABINET WIDTH
B = 20-1/2" DOOR OPENING
C = 19-3/16" CABINET OPENING
D = 18-5/16" MTG. HOLE CENTERS
E = 17-11/16 CLEARANCE BETWEEN RAILS

CEPS-8570-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
THN6142A Cabinet Kit (41-Inch)		PL-1790-A
NON-REFERENCED ITEMS		
	15E841143D01	CABINET (41")
	13C84430D01	DOOR VENT (8 required)
	2S10101A55	SPEED NUT (48 required)



REAR VIEW



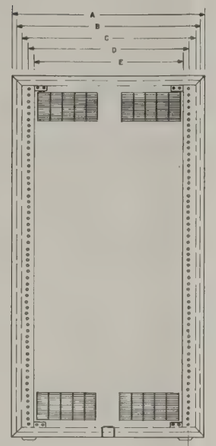
SIDE VIEW

BOTTOM VIEW

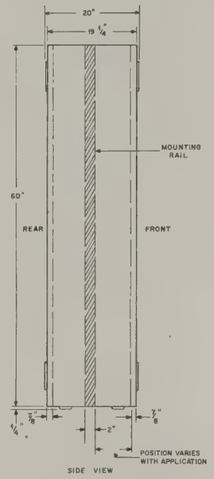
A = 22" CABINET WIDTH
B = 20-1/2" DOOR OPENING
C = 19-3/16" CABINET OPENING
D = 18-5/16" MTG. HOLE CENTERS
E = 17-11/16" CLEARANCE BETWEEN RAILS

CEPS-8571-A

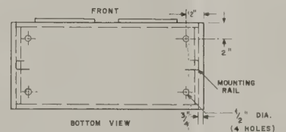
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
THN6243A Cabinet Kit (60-inch)		PL-3401-O
	15-83445H04	CABINET (60-inch)
	13-84430D01	DOOR VENT (8 required)
	2-10101A55	SPEED NUT (48 required)



REAR VIEW



SIDE VIEW



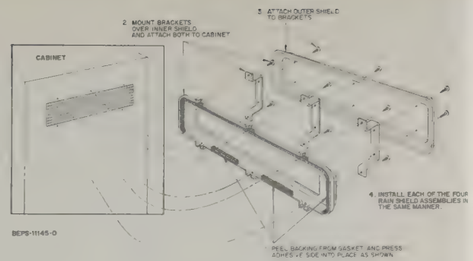
BOTTOM VIEW

A = 22" CABINET WIDTH
B = 20-1/2" DOOR OPENING
C = 19-3/16" CABINET OPENING
D = 18-5/16" MTG. HOLE CENTERS
E = 17-11/16" CLEARANCE BETWEEN RAILS

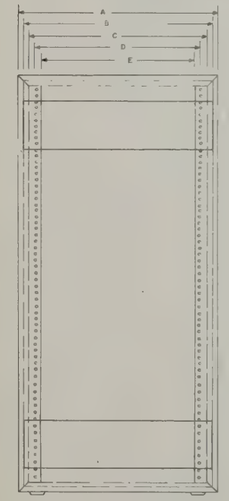
CEPS-17187-A

TLN4862A Outdoor Vent Kit PL-1797-A

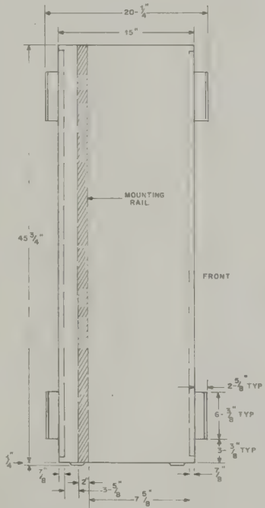
	15-84188D01	COVER, outdoor vent (No. 1); 4 req'd
	15-84189D01	COVER, outdoor vent (No. 2); 4 req'd
	32-84452D01	GASKET: 4 req'd
	32-84452D02	GASKET: 8 req'd
	7-84187D01	BRACKET, vent cover: 12 req'd
	4-490775	FLATWASHER: 24 req'd
	4-9795	LOCKWASHER: 24 req'd
	3-138674	SCREW, machine: 6-32 x 11/16" 24 req'd
	3-138209	SCREW, tapping: 6-32 x 3/8" 24 req'd
	2-7005	NUT, hex: 6-32 x 1/4"; 24 req'd


2. MOUNT BRACKETS OVER INNER SHIELD AND ATTACH BOTH TO CABINET
3. ATTACH OUTER SHIELD TO BRACKETS
CABINET
4. INSTALL EACH OF THE FOUR RAIN SHIELD ASSEMBLIES IN THE SAME MANNER.
PEEL BACKING FROM GASKET AND PRESS ADHESIVE SIDE INTO PLACE AS SHOWN.
BEPS-11145-O

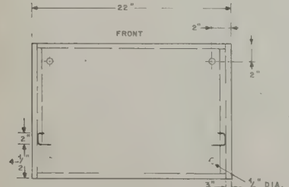
THN6143A Cabinet (46-Inch) Outdoor



REAR VIEW



SIDE VIEW



BOTTOM VIEW

A = 22" CABINET WIDTH
B = 20-1/2" DOOR OPENING
C = 19-3/16" CABINET OPENING
D = 18-5/16" MTG. HOLE CENTERS
E = 17-11/16" CLEARANCE BETWEEN RAILS

CEPS-8572-A

STATION HARDWARE KITS

TRN6197A (12-Watt, 1-Receiver)
TRN6198A (12-Watt, 2-Receiver)
TRN6199A (Hi-Power, 1-Receiver)
TRN6200A (Hi-Power, 2-Receiver) PL-3397-O

	1V80731B73	SHIELD, exciter board
	1V80734B45	SHIELD, power control board
	1V80734B44	SHIELD, receiver rf-if board
	1V80728B57	SHIELD, audio board
	1V80775B76	COVER PLATE ASSY., includes 64-82623K01 COVER, plate (used in hi-power stations)
	1V80775B78	BRACKET ASSY., includes 7-82785K01 BRACKET (used in 12-watt stations)
	1V80775B77	BRACKET ASSY., includes 7-82898K01 BRACKET (used in hi-power stations)
	55-84300B01	HANDLE, plastic
	55-84300B02	HANDLE, plastic
	2-82360B07	SPEEDNUT, special
	3-135038	SCREW, tapping: 1/4"-14x3/4"
	42-83629G01	PIN, accordion
	2-10101A53	NUT, spring
	46-84090C01	STUD, retainer
	3-138162	SCREW, machine: 4-40 x 3/8"
	42-84284B01	RETAINER (BLK)
	33-83051K01	NAMEPLATE
	5-83885G01	RIVET, "Pop"
	13-813618	LABEL (patent)
	54-842366	LABEL (replacement parts)
	54-850440	LABEL (FCC license designation)
	54-83040C01	LABEL (exciter audio)
	66-84387C01	TOOL, tuning
	66-84690C01	TOOL, contact removal
	66-106515	WRENCH, "Allen"
	42-10217A10	"Tywrap"

NOTE:
Except where noted, differences in models are in quantity of parts only.

STATION CABINETS

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

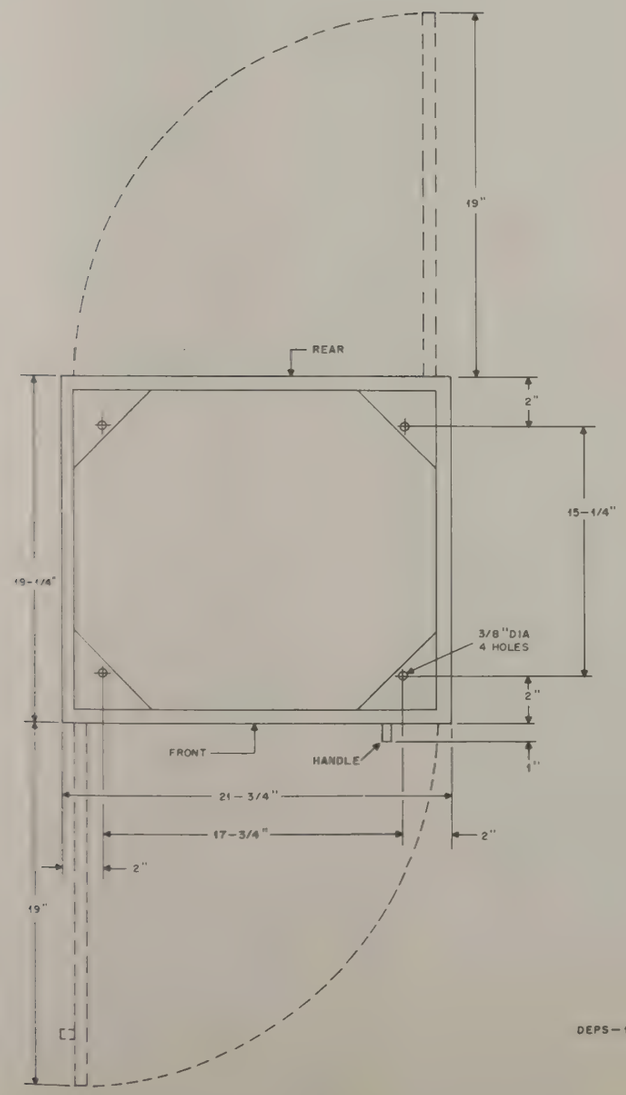
PARTS LIST

TRN6190A Cabinet Hardware Kit (70" and 75") PL-3396-O

	2-836540	NUT, speed: 2 req'd.
	3-839590	SCREW, special (washer-head) 2 req'd.
	2-82360B07	NUT, speed: 1/4"-14; 4 req'd.
	3-135038	SCREW, tapping: 1/4"-14 x 3/4"; 4 req'd.
	3-115727	SCREW, machine: 10-32x1/2"; 2 req'd.
	4-7652	LOCKWASHER: No. 10; 2 req'd.
	37-107997	GROMMET: 2 req'd.
	33-82830H02	LOGO ("MOTOROLA")

THN6194B Cabinet (70-Inch) Indoor

TOP VIEW
(VIEW WITH TOP OFF OF CABINET)

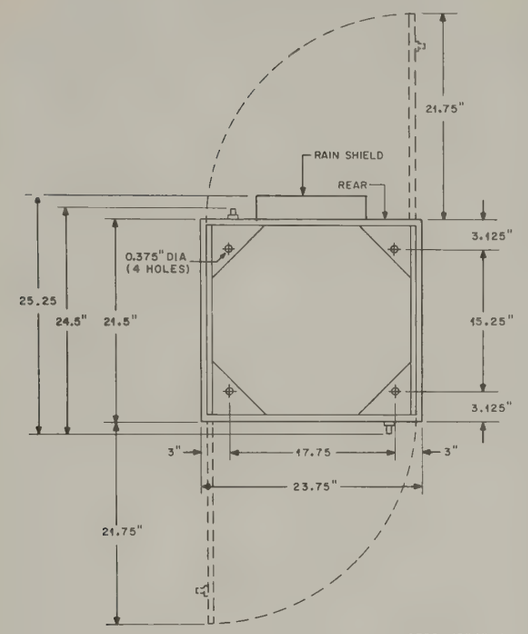


FRONT VIEW

DEPS-15048-A

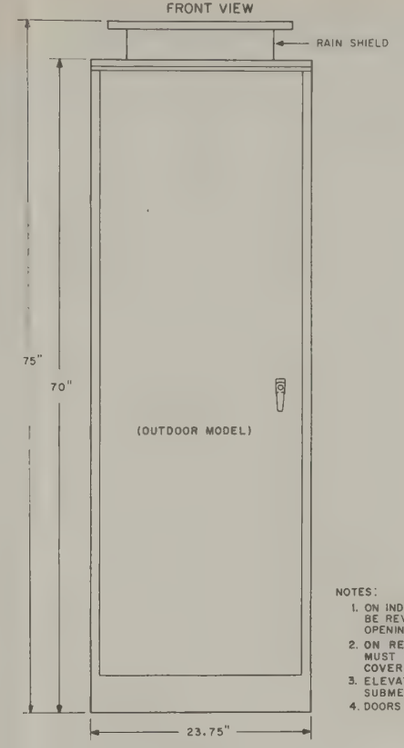
THN6203A Cabinet (75-Inch) Outdoor

TOP VIEW
(VIEW WITH TOP OFF OF CABINET)



CEPS-15049-A

FRONT VIEW



NOTES:
1. ON INDOOR CABINETS, FRONT AND REAR DOORS CAN BE REVERSED FROM RIGHT OPENING TO LEFT HAND OPENING.
2. ON REAR DOOR, OPENING OPPOSITE AIR DUCT MUST BE UNCOVERED AND UNUSED OPENING COVERED (INDOOR CABINETS ONLY).
3. ELEVATE CABINET IF DANGER OF WATER SUBMERSION EXISTS.
4. DOORS ON OUTDOOR CABINETS ARE NOT REMOVABLE.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TLN6892A Rain Shield Kit PL-3402-O

	26-82929H01	SHIELD, rain (top)
	26-84084F01	SHIELD, cover (top)
	15-82926H01	COVER, rain shield
	26-82930H01	SHIELD, rain (door)
	32-82930H01	GASKET, rain shield
	32-82932H02	GASKET, rain shield
	32-84180G01	GASKET: 2 req'd.
	32-84180G02	GASKET: 2 req'd.
	2-10080A03	NUT, spring: No. 8; 4 req'd.
	3-9661	SCREW, machine: 8-32 x 3/8"; 8 req'd.
	3-132823	SCREW, tapping: 8-18 x 3/8"; 4 req'd.
	3-135014	SCREW, tapping: 8-18 x 1/2"; 6 req'd.

Station Cabinets
Dimensional Details and Parts Lists
Motorola No. PEPS-17767-B
(Sheet 2 of 2)
1/4/77-UP

UPRIGHT OUTDOOR CABINET

Option U27 (for Upright Stations)

Option C36 (for "Compa-Station" Base Radios)

MODEL	SUFFIX	DESCRIPTION
THN6203A		75" Cabinet
TRN6720A		Rain Hood Vent Kit (for stations over 110 W only)
TRN6721A		Vent Seal Kit (for stations under 110 W only)

FEATURES

-- Water drainage holes
-- Thick door gaskets
-- Vent seal for stations with less than
-- Vent kit for stations with greater tha

CABINET INSTALLATION

-- Mount on elevated support or platfor
-- Shady or cool area if possible
-- Minimum of eight inches from all ob

INSTALLATION OF TRN6720A RAIN H

-- Mount main section (largest assemb
shaped gasket and 1/2-inch sheet m
-- Install small rectangular cover insid
-- Similarly, mount larger cover on to
-- Mount awning-shaped vent shield ove
3/8-inch sheet metal screws. Pla

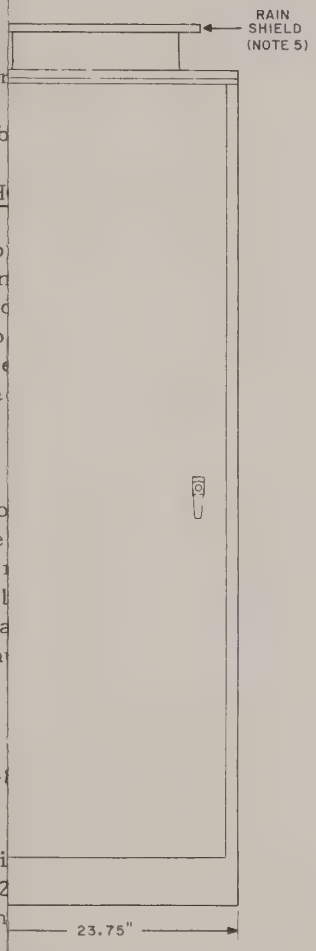
PERIODIC MAINTENANCE

-- Use a paint scraper or putty knife to
cabinet. Use a wire brush or stee
The surface must be cleaned to ba
-- Wipe cleared surface with a clean cl
-- Apply a thin even coat of primer, Pa
coat should dry to the touch in min
No. 11S10026A33 (haze beige).

Be sure water draina
primer.

-- The above primer and paint are avai
ment. Spray paint (Part No. 11-82
also available from Parts Departm
recommended.
-- The above kits and paint can be obta
Department, 10 West North Avenue

FRONT VIEW



NOTES:

1. THE INDOOR CABINET FRONT AND REAR DOORS CAN BE CHANGED TO ALLOW LEFT-HAND OPENING INSTEAD OF RIGHT-HAND OPENING.
2. IF THE DOOR OPENING CHANGE MENTIONED IN NOTE 1 IS MADE, BE SURE TO RELOCATE THE VENT COVER TO THE UNUSED OPENING.
3. ELEVATE OUTDOOR CABINETS IF DANGER OF WATER SUBMERSION EXISTS.
4. DOORS ON OUTDOOR CABINET ARE NOT REMOVABLE
5. STATIONS OVER 110 WATTS OUTPUT USE TRN6720A VENT KIT. STATIONS BELOW 110 WATT OUTPUT USE TRN6721A VENT SEAL KIT

6721A Vent Seal Kit PL-5106-O

	2-10080A03	NUT, spring; #8; 6 used
	3-132823	SCREW, tapping; #8-18 x 3/8" 4 used
	3-135014	SCREW, tapping; #8-18 x 1/2; 6 used
	26-83956H01	SHIELD (2 hole)
	26-83956H03	SHIELD (1 hole)
	32-82499L01	GASKET; 13.0 x 4.5"
	32-82499L02	GASKET; 13.0 x 7.25"

UPRIGHT OUTDOOR CABINET

Option U27 (for Upright Stations)

Option C36 (for "Compa-Station" Base Radios)

MODEL	SUFFIX	DESCRIPTION
THN6203A		75" Cabinet
TRN6720A		Rain Hood Vent Kit (for stations over 110 W only)
TRN6721A		Vent Seal Kit (for stations under 110 W only)

FEATURES

-- Water drainage holes
-- Thick door gaskets
-- Vent seal for stations with less than 110 W output
-- Vent kit for stations with greater than 110 W output

CABINET INSTALLATION

-- Mount on elevated support or platform
-- Shady or cool area if possible
-- Minimum of eight inches from all obstructions

INSTALLATION OF TRN6720A RAIN HOOK VENT KIT

-- Mount main section (largest assembly) over opening in top of cabinet using rectangular shaped gasket and 1/2-inch sheet metal screws provided.
-- Install small rectangular cover inside main section using machine screws provided.
-- Similarly, mount larger cover on top of entire assembly.
-- Mount awning-shaped vent shield over rear door opening using "U" shaped gasket and 3/8-inch sheet metal screws. Place acorn nuts over screws to cover exposed threads.

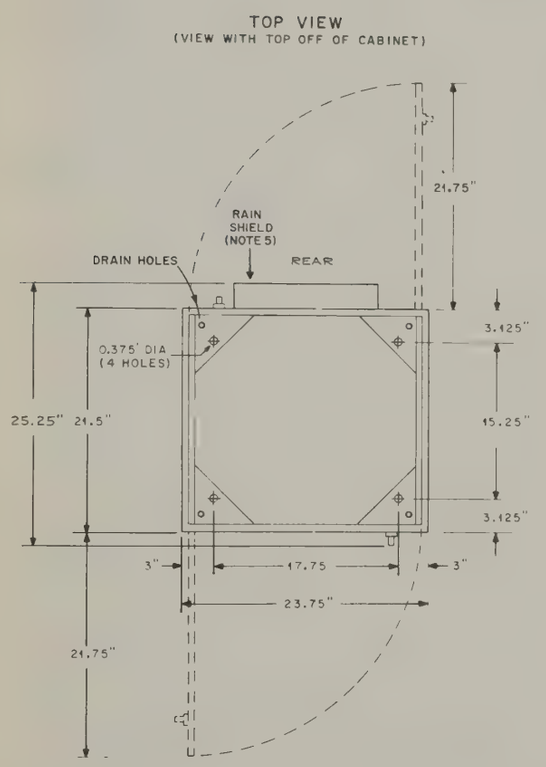
PERIODIC MAINTENANCE

-- Use a paint scraper or putty knife to remove all loose paint and paint blisters from the cabinet. Use a wire brush or steel wool to remove remaining rust from the area. The surface must be cleaned to bare metal and free of all rust.
-- Wipe cleared surface with a clean cloth.
-- Apply a thin even coat of primer, Part No. 11S1003A42, to all exposed metal. This coat should dry to the touch in minutes. Apply an even smooth coat of paint, Part No. 11S10026A33 (haze beige).

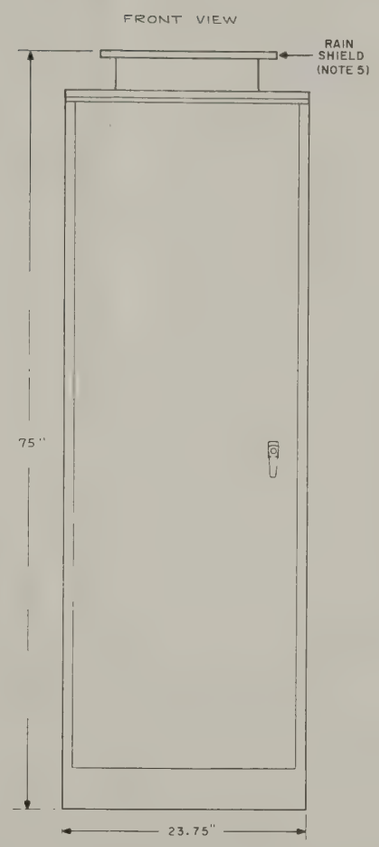
NOTE

Be sure water drainage holes are cleared of all paint and primer.

-- The above primer and paint are available from Communications Division Parts Department. Spray paint (Part No. 11-82716A05) and spray primer (Part No. ST-433) are also available from Parts Department. However, spraying paint inside cabinet is not recommended.
-- The above kits and paint can be obtained from Motorola Communications Division Parts Department, 10 West North Avenue, Lombard, Illinois 60148.



CEPS-22346-O



NOTES:

1. THE INDOOR CABINET FRONT AND REAR DOORS CAN BE CHANGED TO ALLOW LEFT-HAND OPENING INSTEAD OF RIGHT-HAND OPENING
2. IF THE DOOR OPENING CHANGE MENTIONED IN NOTE 1 IS MADE, BE SURE TO RELOCATE THE VENT COVER TO THE UNUSED OPENING.
3. ELEVATE OUTDOOR CABINETS IF DANGER OF WATER SUBMERSION EXISTS
4. DOORS ON OUTDOOR CABINET ARE NOT REMOVABLE
5. STATIONS OVER 110 WATTS OUTPUT USE TRN6720A VENT KIT. STATIONS BELOW 110 WATT OUTPUT USE TRN6721A VENT SEAL KIT

TRN6720A Rain Hood Vent Kit PL-5107-O

	2-10080A03	NUT, spring, #8; 6 used
	3-9661	SCREW, machine; 8-32 x 3/8"; 8 used
	3-132823	SCREW, tapping; 8-18 x 3/8; 4 used
	3-135014	SCREW, tapping; 8-18 x 1/2; 8 used
	15-82433L01	HOOD, door vent
	15-82926H01	COVER, rain shield
	26-82929H01	SHIELD, rain top
	26-84084F01	SHIELD, cover top
	32-82499L01	GASKET; 13.0 x 4.5"
	32-82499L02	GASKET; 13.0 x 7.25"
	32-84180G01	GASKET; 6-hole; 2 used
	32-84180G02	GASKET; 4-hole; 2 used

TRN6721A Vent Seal Kit PL-5106-O

	2-10080A03	NUT, spring; #8; 6 used
	3-132823	SCREW, tapping; #8-18 x 3/8" 4 used
	3-135014	SCREW, tapping; #8-18 x 1/2; 6 used
	26-83956H01	SHIELD (2 hole)
	26-83956H03	SHIELD (1 hole)
	32-82499L01	GASKET; 13.0 x 4.5"
	32-82499L02	GASKET; 13.0 x 7.25"

THN6203A Cabinet (75-Inch) PL-5198-O

	15-82123H05	CABINET, outdoor

68P81033E42-O
1/11/77-

TATION" OUTDOOR CABINET

Option C27 (for "Compa-Station" Base Radios)

MODEL	SUFFIX	DESCRIPTION
THN6142A		46" Cabinet (vented for continuous duty only)
THN6303A		46" Cabinet (sealed for intermittent duty only)
TLN4862A		Outdoor Vent Kit
TRN6448A		Cabinet Hardware Kit

FEATURES

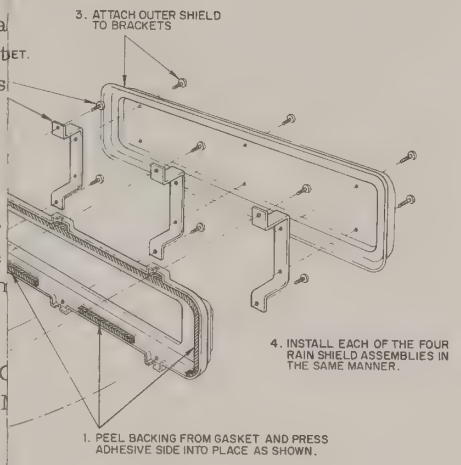
-- Water drainage holes
-- Rust resistant equipment mou
-- Thick door gaskets
-- Screw and flange type door la
-- Vent seal for intermittent dut
-- Vent kit for continuous duty s
-- Sealed cabinet corner joints

CABINET INSTALLATION

-- Mount on elevated support or
-- Shady or cool area if possible
-- Minimum of eight inches fron

CAUTION

LOOSEN BOTH DOOR LATC
OPENING CABINET OR DA
DOOR MAY RESULT.


3. ATTACH OUTER SHIELD TO BRACKETS
4. INSTALL EACH OF THE FOUR RAIN SHIELD ASSEMBLIES IN THE SAME MANNER.
1. PEEL BACKING FROM GASKET AND PRESS ADHESIVE SIDE INTO PLACE AS SHOWN.

FERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

RTS LIST

4862A Outdoor Vent Kit PL-1797-A

	15-84188D01	COVER, outdoor vent (No. 1); 4 req'd
	15-84189D01	COVER, outdoor vent (No. 2); 4 req'd
	32-84452D01	GASKET: 4 req'd
	32-84452D02	GASKET: 8 req'd
	7-84187D01	BRACKET, vent cover: 12 req'd
	4-490775	FLATWASHER: 24 req'd
	4-9795	LOCKWASHER: 24 req'd
	3-138674	SCREW, machine: 6-32 x 11/16" 24 req'd
	3-138209	SCREW, tapping: 6-32 x 3/8" 24 req'd
	2-7005	NUT, hex: 6-32 x 1/4"; 24 req'd

"COMPA-STATION" OUTDOOR CABINET

Option C27 (for "Compa-Station" Base Radios)

MODEL	SUFFIX	DESCRIPTION
THN6142A		46" Cabinet (vented for continuous duty only)
THN6303A		46" Cabinet (sealed for intermittent duty only)
TLN4862A		Outdoor Vent Kit
TRN6448A		Cabinet Hardware Kit

FEATURES

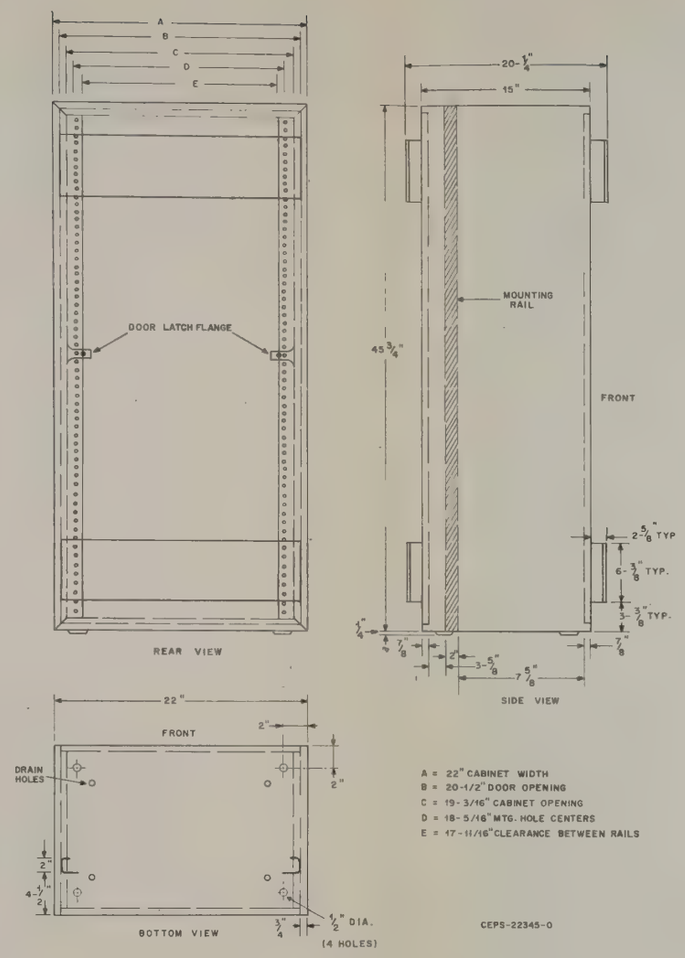
-- Water drainage holes
-- Rust resistant equipment mounting rails
-- Thick door gaskets
-- Screw and flange type door latches
-- Vent seal for intermittent duty stations
-- Vent kit for continuous duty stations
-- Sealed cabinet corner joints

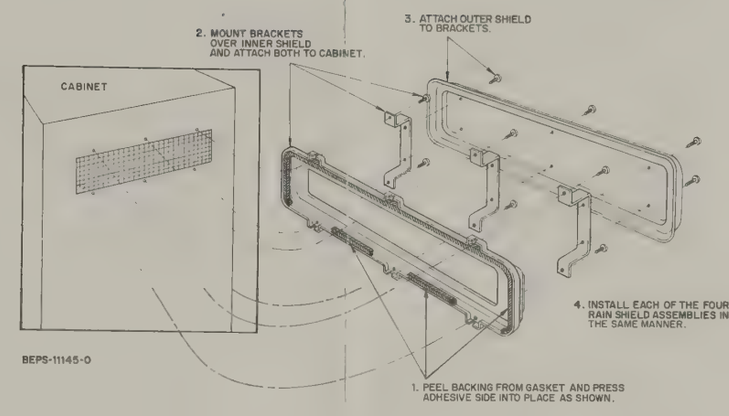
CABINET INSTALLATION

-- Mount on elevated support or platform
-- Shady or cool area if possible
-- Minimum of eight inches from all obstructions

CAUTION

LOOSEN BOTH DOOR LATCHES BEFORE OPENING CABINET OR DAMAGE TO THE DOOR MAY RESULT.




2. MOUNT BRACKETS OVER INNER SHIELD AND ATTACH BOTH TO CABINET.
3. ATTACH OUTER SHIELD TO BRACKETS.
CABINET
4. INSTALL EACH OF THE FOUR RAIN SHIELD ASSEMBLIES IN THE SAME MANNER.
BEPS-11145-O
1. PEEL BACKING FROM GASKET AND PRESS ADHESIVE SIDE INTO PLACE AS SHOWN.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TRN6448A Cabinet Hardware Kit — PL-3626-O

	2-836540	SPEED NUT (4 req'd.)
	3-135499	SCREW, tapping; 1/4 - 14 x 5/8" (4 req'd.)

THN6303A Sealed 46-Inch Cabinet
(For Intermittent Duty Station) — PL-5105-O

	15-84144D11	CABINET, outdoor

THN6143A Vented 46-Inch Cabinet
(For Continuous Duty Stations) — PL-5104-O

	15-84144D08	CABINET, outdoor

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN4862A Outdoor Vent Kit — PL-1797-A

	15-84188D01	COVER, outdoor vent (No. 1); 4 req'd
	15-84189D01	COVER, outdoor vent (No. 2); 4 req'd
	32-84452D01	GASKET: 4 req'd
	32-84452D02	GASKET: 8 req'd
	7-84187D01	BRACKET, vent cover: 12 req'd
	4-490775	FLATWASHER: 24 req'd
	4-9795	LOCKWASHER: 24 req'd
	3-138674	SCREW, machine: 6-32 x 11/16" 24 req'd
	3-138209	SCREW, tapping: 6-32 x 3/8" 24 req'd
	2-7005	NUT, hex: 6-32 x 1/4"; 24 req'd

68P81033E46-O
1/11/77-

TAB 1. DESCRIPTION

TAB 2. INSTALLATION

TAB 3. STATION MAINT
POWER SUPPLY

STATION MAINTENANCE
MAINTENANCE LOG SHEET
METERING & INTERCOM
POWER SUPPLY

TAB 4. TRANSMITTER

ALIGNMENT
MAINTENANCE
INTERCONNECT BOARD
EXCITER/1ST BANDPASS FILTER
POWER AMPLIFIERS
POWER CONTROL BOARD/
ANTENNA NETWORK/CONTROL STAGE
"PRIVATE–LINE" ENCODERS

TAB 5. RECEIVER

ALIGNMENT
MAINTENANCE
INTERCONNECT BOARD
RF & IF
AUDIO & SQUELCH
"PRIVATE–LINE" DECODERS

1. INTRODUCTION

This section of the manual describes local operation techniques required to perform maintenance checks. Overall station maintenance is detailed in this section while specific chassis maintenance (transmitter, receiver or power supply, etc.) is provided with the applicable section. Maintenance checks for control modules are given with the applicable module in separate Control and Applications Instruction Manual 68P81025E60.

2. LOCAL OPERATION FOR TESTING & MAINTENANCE

2.1 Once power is applied and the station is properly adjusted, this base or repeater station is normally operated entirely unattended from a remote control point. However, the station may be locally operated utilizing controls on control modules in the unified chassis. This type of operation may be necessary to accomplish station maintenance and testing.

2.2 Local operation of the station is primarily accomplished utilizing controls on the station control module located in the unified chassis. The controls and function are listed in the table on this page.

WARNING

The transmitter can be keyed remotely. To prevent unexpected transmitter keying while servicing the station, be sure the LINE DISABLE switch is actuated (direction of arrow). Also, the TLN4662A Squelch Gate Module must be temporarily removed from the remote control chassis if the station is equipped with any of the following dc transfer modules:

TLN4637A (no suffix)
TLN4659A (no suffix)
TLN4664A (no suffix)

STATION CONTROL MODULE CONTROLS

CONTROL	POSITION	FUNCTIONS POSSIBLE
XMIT	Normal (not actuated)	Normal mode of operation.
	Actuated (hold to right)	Turns on transmitter with no modulation. Use test microphone connected to Local Mike receptacle to modulate transmitter.
"PL" DISABLE* (functional only in "Private-Line" stations)	Normal (left)	Only "PL" tone-coded on-frequency signals accepted by receiver.
	Actuated (right)	All on-frequency signals accepted by receiver.
LINE DISABLE*	Normal (left)	Transmitter can be operated by: 1. XMIT switch 2. Local microphone 3. Remote control console
	Actuated (right)	Transmitter can not be operated by remote control console over control line.

*The DISABLE LIGHT is illuminated when the LINE DISABLE or "PL" DISABLE switch is actuated.

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Communications Division

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2.3 The following are procedures pertaining to the local operation of a remotely controlled station or repeater station.

2.3.1 Transmitter Control

To prevent the transmitter from being keyed remotely, set station control module LINE DISABLE switch in the direction of the arrow. At conclusion of local operation, insure that the LINE DISABLE switch is returned to its normal position (opposite direction of the arrow).

2.3.2 Local Microphone

2.3.2.1 Stations Without Built-In Metering

Connect a "Micor" microphone (Motorola Model TMN6054A or equivalent) to the microphone receptacle on the unified chassis interconnect board (part of J4, pins 3, 4, 5, 14, 15 and 16).

2.3.2.2 Stations With Built-In Metering

Connect a Motorola Model (TMN6071A microphone, or equivalent to the MICROPHONE receptacle on the metering chassis.

2.3.3 Local Speaker

2.3.3.1 Stations Without Built-In Metering

Connect any 8-ohm, 10-watt test speaker to J4, pins 1 and 12, on the unified chassis interconnect board. This speaker is used to monitor all received messages. A Motorola "Micor" speaker (Models TSN6016A or B, TSN6020A) plugs directly into these pins without requiring any adapter.

2.3.3.2 Stations With Built-In Metering

Place the SPEAKER ON-OFF switch to the ON position.

2.3.4 Portable Test Set (For Stations Without Built-In Metering)

A Motorola S1056B-S1059B Series Portable Test Set with TEK-37 or TEK-37A Adapter Cable can be used as a local control facility. Connect the red "control" plug of the adapter cable to the metering receptacle (J3) on the unified chassis interconnect board. The speaker in the test set can be used for monitoring received signals and a "Motrac" microphone (Model TMN6071A) connected to the microphone receptacle on the test set can be used for originating transmissions. The XMIT button on the test set can be used to key the transmitter without voice modulation.

2.3.5 Frequency Selection

For stations with a two-frequency transmitter, the frequency can be locally selected by the F1-F2 switch on the dc transfer module or on the F2 tone decoder module. For stations with a two-frequency receiver, frequency selection is made by momentarily operating the REC F1 SELECT or REC F2 SELECT switch on the dc transfer module or on the F2 tone decoder module. For four-frequency stations, the frequency is selected by momentary operation of the desired frequency select switch on the four-frequency module after the XMIT switch on the station control module is operated.

2.3.6 Selection of Other Modes

All other functions that can be activated by remote control can also be activated locally. Each module has test switches to activate any such functions, such as RPTR ON and RPTR OFF. Most of these switches are momentary action, which allows the station to continue operating in the selected mode until reset.

2.3.7 Received Audio

After the local speaker is turned on or connected, the station is ready to receive audio. The receiver "PL" feature, if used, can be defeated by setting the station control module "PL" DISABLE switch in the direction of the arrow. (At the conclusion of local operation, insure that the "PL" DISABLE switch is returned to its normal position.) If necessary, the receiver can be unsquelched utilizing the receiver SQUELCH control on the receiver chassis. The VOLUME control on the receiver chassis sets the audio output level of the local speaker.

2.3.8 Transmitting

NOTE

Before initiating any local transmissions, monitor the channel to insure that it is clear of other transmissions.

The transmitter is keyed locally by either activating the station control module XMIT switch or activating the push-to-talk microphone switch. Voice is transmitted using the local microphone.

2.3.9 Concluding Local Operation

At the conclusion of local operation, perform the following operations and checks to

insure that the station is ready for remote operation.

Step 1. Reset receiver squelch level per procedures in Receiver Section (Audio & Squelch) of this manual.

Step 2. Insure that station control module switches are positioned for normal operation (reference table).

Step 3. Disconnect microphone and test speaker (if used).

Step 4. Set all external power switches ON.

Step 5. Insure that station is operable from remote location.

Step 6. Turn local speaker OFF (if applicable).

Step 7. Disconnect or remove any metering plugs or test set.

Step 8. Insure that cabinet doors are locked.

Step 9. Insure that vents in cabinet are unobstructed.

3. MAINTENANCE TECHNIQUES

3.1 GENERAL

Maintenance procedures for individual chassis which comprise this station are contained in the applicable section of this manual. Module maintenance information is provided in separate manual 68P81025E60. As an aid to isolating a malfunction to a specific chassis or module, a variety of techniques are appropriate.

3.2 TRANSMITTER AND RECEIVER

Most troubles in the transmitter or receiver can be quickly isolated with metering checks. A log of normal meter readings for this station should be maintained. Each time maintenance is performed, the meter readings should be entered into the log. Variations from the previous readings can isolate a malfunction or may indicate an impending failure. If no previous meter readings are available, typical or minimum meter readings may be found with the receiver rf & i-f, exciter, power amplifier or power control board instruction sections, as well as metering procedures.

3.3 POWER SUPPLY

A check of power supply voltages under load and no-load conditions (transmit and standby) should quickly isolate any malfunction.

3.4 REMOTE CONTROL UNIT

Isolation of a malfunction in the control portion of the unified chassis requires a functional understanding of the overall station operation and the inter-relationship between the various modules and chassis of the station. The "Functional Description" section along with the REMOTE CONTROL MODULE DIAGRAMS section of manual 68P81025E60 provide necessary information. With a basic understanding of station operation, troubles may be isolated by analyzing the following questions:

(1) Can the station be operated locally but not remotely? If so, this eliminates many circuits as possible sources of trouble.

(2) How many modes are inoperable? Concentrate testing on circuits that are common to the inoperable modes.

(3) Are adjustments properly set? This includes audio level adjustments at the station and at the remote control point.

(4) Are jumpers properly installed? The many jumpers in this equipment provides vast flexibility, but could be a source of trouble if improperly added, removed, or not removed as the case may be.

4. ROUTINE MAINTENANCE CHECK LIST

ITEM	CHECK
Receiver	Measure the signal level required to obtain 20 dB quieting.
	Compare meter readings with the minimum value and all previous readings taken. Realign the receiver, if necessary.
	For PL stations, check for proper operation of the PL decoder. Does the squelch open when the proper PL tone-or binary-code is detected?
Transmitter	Measure transmitter output power.
	Compare meter readings with the minimum value and all previous readings taken. Realign the transmitter, if necessary.
	Verify that each transmitter channel is on frequency and adjust if necessary.
	Tune and load the transmitter to the antenna.
	Measure transmitter frequency deviation for both voice and PL coded modulation. Adjust the "IDC" control, if necessary.
	Measure the exciter modulator sensitivity.
System Operation	Measure and adjust the audio input to the exciter.
	Measure and adjust the receiver(s) audio output to the control line.
	Check control line levels and functions for proper operation.
	Adjust receiver(s) on frequency with the distant transmitter(s) in the system.
	Check for proper repeater operation on repeater models.
	Check all accessory equipment for proper operation.
After Performing Maintenance	Check all items listed in the Concluding Local Operation paragraph of this section of the instruction manual.

5. TABLE OF RECOMMENDED TEST EQUIPMENT

TYPE OF EQUIPMENT OR TYPE OF MEASUREMENT	EQUIPMENT CHARACTERISTICS	RECOMMENDED TYPE
Transmitter Frequency Measurement	Frequency -406-512 MHz Accuracy - ±.00005% or better	Any of the following items of Motorola Test Equipment: Model R1200A Service Monitor Model S1344A Frequency Counter & Deviation Meter Model S1343A Frequency Counter
Transmitter Deviation Measurement See Note 1	Peak reading type for voice or sinusoidal wave; scales for accurate reading of ±5 kHz deviation (and ±1 kHz deviation for "Private-Line" models)	Any of the following items of Motorola Test Equipment: Model R1200A Service Monitor Model S1344 Frequency Counter & Deviation Meter Model S1323A Deviation Meter
Transmitter Power Output Measurement	406-512 MHz; 50 ohms; at least 0-100 watts. 50-ohm dummy load; at least 100 watts	Motorola Wattmeter with appropriate element Motorola Model T-1013A RF Load Resistor
RF Signal Generator for receiver testing See Note 2	406-512 MHz; FM; high-stability-(±.0002% or better); adjustable output 0 to 1000 microvolts	Motorola Model R1200A Service Monitor Motorola S1318A Series FM Signal Generator
Audio Voltage Measurements Audio Signal Generator For audio circuit testing in receiver and transmitter	High impedance (10 megohm); dBm scale Variable amplitude 0 to 1 volt; 1000-Hz tone (300- to 3000-Hz preferred); sinusoidal wave	Motorola Model S1053C Solid-State AC Voltmeter Motorola Model S1067B Solid-State Audio Oscillator Motorola Model TEK-1B Tone Oscillator Motorola Model R1200A Series Service Monitor

TABLE OF RECOMMENDED TEST EQUIPMENT (Cont'd.)

TYPE OF EQUIPMENT OR TYPE OF MEASUREMENT	EQUIPMENT CHARACTERISTICS	RECOMMENDED TYPE
DC Voltage Measurements, Resistance Measurements, RF Voltage Measurements	High impedance (11 megohm) dc multimeter	Motorola S1063B Solid-State DC Multimeter with SLN6055A RF Probe Motorola Model T1048A Digital Multimeter
Waveform Measurements	Oscilloscope: Audio Circuit measurements RF circuit measurements, at least 50 MHz bandwidth	A very high quality instrument is required
Tone "Private-Line" injection for PL decoder circuit measurements	"Private-Line" tone generator using "Vibrasender" resonant reed for frequency accuracy; or audio oscillator with frequency counter for accurate setting of oscillator.	Motorola Model S1333A Audio Synthesizer Motorola Model SLN6221A "Private-Line" Tone Generator
"Digital Private-Line" encoder and decoder measurements	"Digital Private-Line" encoder and decoder. Also tests digital code plugs	Motorola Model SLN6413A "Digital Private-Line" Test Set
Tuning Tool	Used for adjusting all tunable components during equipment alignment.	Motorola part number 66A84387C01
Contact Removal Tool	Used to remove female wire terminals from metering cable connector	Motorola part number 66B84690C01

NOTES:

1. For "Digital Private-Line" stations, the Transmitter Deviation Monitor must have a low frequency response of less than 1 Hz. The Motorola R1200A Service Monitor with deviation monitor and oscilloscope plug-in modules requires modification to meet this requirement. No alternate test equipment is recommended.

2. For "Digital Private-Line" stations the rf signal generator must accept external modulation with a low frequency response of less than 1 Hz (essentially dc). The Motorola S1318A Series FM Signal Generator and the R1200A Service Monitor meet this requirement. Most other signal generators will probably not meet this specification.

ENANCE LOG SHEET

ITEM
Transmitter Output Power
Transmitter Deviation:
With 1000 Hz @1 volt mod
With PL tone-coded modu
Receiver 20 dB Quieting Level
(less preampl or 2-wire c
Frequency Measurement (Note
Exciter Audio Input Level (XC
Receiver Audio Output Line (L
Repeater Level, if applicable
Control Line DC Current Leve
Function Tone Frequencie
Transmit F1
Transmit F2
Transmit F3
Transmit F4
Disable Receiver PL
Mute R2
Unmute R2

NOTES:
1. Enter data from factor
2. Transmitter frequency
3. Refer to the Installatio

TABLE 1

ANGE/POWER OUTPUT LEVEL

70 MHz	470-494 MHz (Note 1)	494-512 MHz (Note 1)
W	12 W	12 W
W	20 W	20 W
W	40 W	40 W
W	60 W	60 W

e set for indicated power output or less depending
g.
output should be measured at the output of this antenna
of coaxial cable between the wattmeter and antenna

TES & HISTORICAL NOTES

nce problems encountered during servicing,
ification kits, and other items needed for historical

CHASSIS METERED	METER SWITCH POSITION	
RECEIVER	1	Cha
	2	1st
	3	2nd
	4 - and +	Dis
	5	Lin
XCTR	1	"ID
	2	Cha
	3	Tri
	4	1st
	5	Exc
POWER AMPL	1	
	2	Dri
		Onl
	3	PA
	5	1st
POWER CONTROL	1	For
	2	Ref
	5	Con

NOTES:
1. On multiple frequency
2. Enter data from factory
3. Reading should be 1 uA
4. The "IDC" audio should
5. See the complete transr

EPS-17655-O

STATION OPERATING PARAMETERS

ITEM	TYPICAL VALUE	FACTORY TEST (Note 1)	DATE WHEN PLACED IN SERVICE	1ST CHECK DATE	2ND CHECK DATE	3RD CHECK DATE	4TH CHECK DATE	5TH CHECK DATE	6TH CHECK DATE
Transmitter Output Power	See Table I								
Transmitter Deviation:									
With 1000 Hz @1 volt modulation	±5 kHz								
With PL tone-coded modulation	0.5 to 1 kHz								
Receiver 20 dB Quieting Level (less preampl or 2-wire coupler)	Less than 0.5 uV								
Frequency Measurement (Note 2):									
T1									
T2									
T3									
T4									
R1									
R2									
R3									
R4									
Exciter Audio Input Level (XCTR LEVEL):	Note 3								
Receiver Audio Output Line (LINE OUTPUT):	Note 3								
Repeater Level, if applicable	Note 3								
Control Line DC Current Levels and/or									
Function Tone Frequencies									
Transmit F1									
Transmit F2									
Transmit F3									
Transmit F4									
Disable Receiver PL									
Mute R2									
Unmute R2									

NOTES:
1. Enter data from factory test tickets provided with the station at time of shipment.
2. Transmitter frequency stability is ±0.0002%. Receiver frequency stability is ±0.0002% with AFC. Refer to receiver section for setting and measurement procedure.
3. Refer to the Installation & Adjustments section of this instruction manual for set up procedure and typical value.

STATION METER READINGS (Note 1)

CHASSIS METERED	METER SWITCH POSITION	FUNCTION	TYPICAL METER READING	FACTORY TEST (Note 2)	DATE WHEN PLACED IN SERVICE	1ST CHECK DATE	2ND CHECK DATE	3RD CHECK DATE	4TH CHECK DATE	5TH CHECK DATE	6TH CHECK DATE
RECEIVER	1	Channel Element Output	15 uA								
	2	1st Doubler Output	15 uA								
	3	2nd Doubler Output	15 uA								
	4 - and -	Discriminator Output	0±2 uA								
	5	Limiter Output	10 uA								
XCTR	1	"IDC" Audio Output	Note 4								
	2	Channel Element Output	25 uA								
	3	Tripler Input	38 uA								
	4	1st Doubler Input	22 uA								
	5	Exciter Output	25 uA								
POWER AMPL	1		15 uA (min)								
	2	Driver Current (75 Watt Only)	6-18 uA								
	3	PA Current	24-28								
	5	1st Stage Voltage	3-25								
POWER CONTROL	1	Forward Output Power	24-50 uA								
	2	Reflected Power	5-20 uA								
	5	Control Voltage	3-25 uA								

NOTES:
1. On multiple frequency stations, repeat test for each operational frequency.
2. Enter data from factory test tickets provided with station at time of shipment.
3. Reading should be 1 uA or less. If measurement is not readable, inject an on-channel signal @1.0 mV into the receiver input receptacle. A 20 uA typical reading should be obtained.
4. The "IDC" audio should be 2 uA without modulation and 10 uA with 120 mV @1000 Hz modulation applied to the microphone input.
5. See the complete transmitter alignment procedure included in this section of the manual for typical values.

MAINTENANCE LOG SHEET

TABLE 1

FREQUENCY RANGE/POWER OUTPUT LEVEL

MODEL SERIES	406-420 MHz	450-470 MHz	470-494 MHz (Note 1)	494-512 MHz (Note 1)
B/C33RCB	12 W	12 W	12 W	12 W
B/C43RCB	--	20 W	20 W	20 W
B/C53RCB	45 W	45 W	40 W	40 W
B/C63RCB	75 W	75 W	60 W	60 W

NOTES:
1. 470-512 MHz models should be set for indicated power output or less depending of system licensed ERP rating.
2. All frequency ranges - power output should be measured at the output of this antenna network using one foot or less of coaxial cable between the wattmeter and antenna network output connector.

SERVICING NOTES & HISTORICAL NOTES

DATE	ITEM (First maintenance problems encountered during servicing, addition of modification kits, and other items needed for historical purposes.)

REFERENCE SYMBOL

PARTS LI

TLN5657A Me

C100

CR100, 101

J1

LS1

M100

P100
P101
P102

R100
R101
R102

S1
S2, 3

NON

NOTE:
For optimu , place the
ordered by KER position.
from the re-
the speaker.

"COMPA-STATION" METERING & INTERCOM

MODEL TLN1740A

INTERCOM

MODEL TLN1745A

FUNCTION -

--Model TLN1740A provides built-in metering of over 20 major test points in the transmitter and receiver(s), plus intercom between the station and the remote control point.

--Model TLN1745A provides intercom between the station and the remote control point.

MIC AUDIO IS ULTIMATELY APPLIED TO REMOTE CONTROL POINT.

METER SELECT TABLE

P102 METERING PLUG CONNECTED TO	METER SELECTOR SW MTR NO.		POSITION	FUNCTION METERED	
RCVR RF & IF BOARD	RECEIVER	1	1	CHANNEL ELEMENT OUTPUT (3RD HARMONIC)	
		2	2	1ST DOUBLER OUTPUT	
		3	3	2ND DOUBLER OUTPUT	
		4 (+)	4	DISCRIMINATOR OUTPUT	
		4 (-)	5	DISCRIMINATOR OUTPUT	
		5	6	LIMITER OUTPUT	
POWER AMPLIFIER	PWR AMP	1	7	PRE DRIVER CURRENT	
		2	8	25 W DRIVER CURRENT (75 W MODEL ONLY)	
		3	9	FINAL AMPLIFIER CURRENT (EXCEPT 12 W STATIONS)	
		5	10	CONTROLLED (ADL) STAGE VOLTAGE	
POWER CONTROL BOARD	PWR CONT	5	11	FINAL AMPLIFIER CURRENT (12 W STATIONS ONLY)	
		3	12	ADL VOLTAGE	
		2	13	REFLECTED POWER	
		1	14	FORWARD POWER	
—	—	—	15	UNUSED	
EXCITER	EXCITER	6	16	UNUSED	
		5	17	EXCITER OUTPUT	
		4	18	DOUBLER INPUT	
		3	19	TRIPLER INPUT	
		2	20	CHANNEL ELEMENT OUTPUT	
		1	21	"IDC" AUDIO OUTPUT	
—	—	—	22	25 VOLTS FULL SCALE	(NOTE: METER IS LABELLED 0–50)
—	—	—	23	5 VOLTS FULL SCALE	
—	—	—	24	OFF	

NOTE
WITH 12 W STATIONS, FINAL PA CURRENT IS METERED AT PWR CONT MTR 5. WITH ALL OTHER STATIONS, FINAL PA CURRENT IS METERED AT PA MTR 3.

NOTE
1. THIS OPTION REQUIRES THE USE OF A MOTOROLA MODEL TMN6071A MICROPHONE, OR EQUIVALENT.

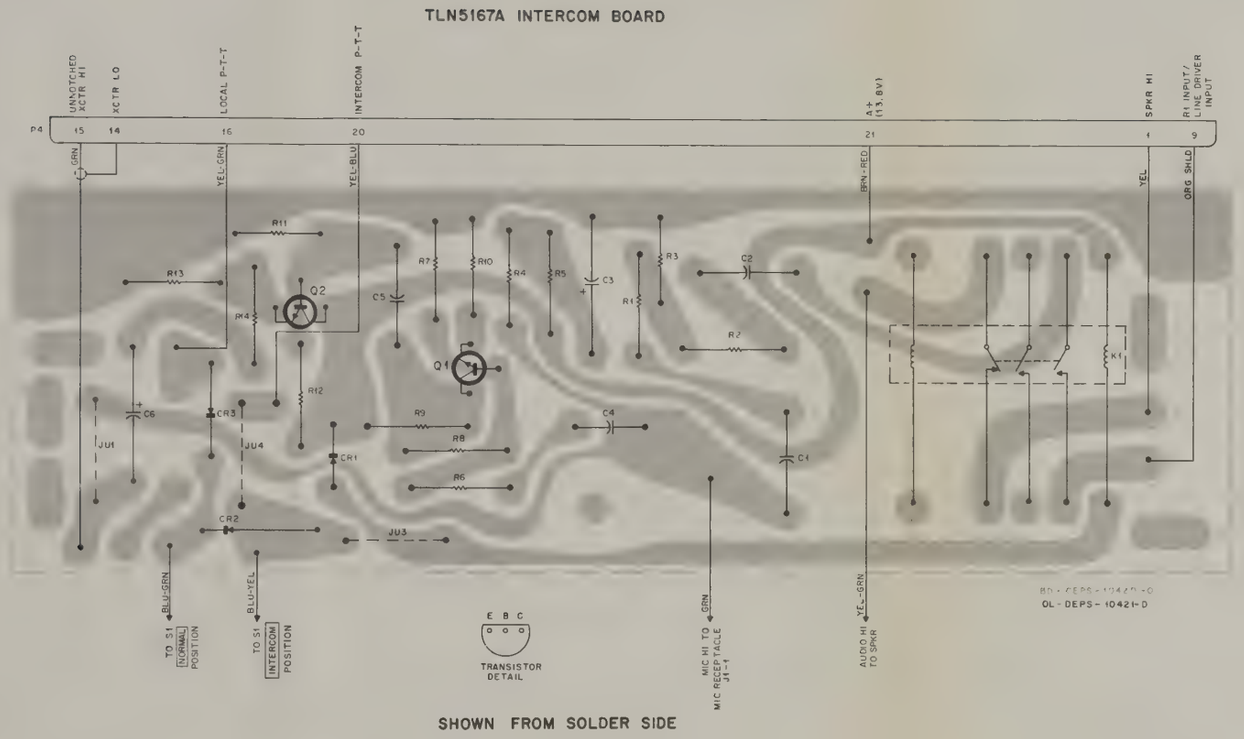
JUMPER TABLE

JUMPER	NORMAL	WHEN "SPECTRA TAC" IS ADDED (CUT CR2)
JU1	OUT	OUT
JU2	OUT	IN
JU3	OUT	IN

LEGEND

= THEORY OF OPERATION DATA

= PRIMARY SIGNAL FLOW



SHOWN FROM SOLDER SIDE

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN1552A Meter Chassis & Intercom Kit
TLN5167A Intercom Board PL-2156-C

		CAPACITOR, fixed: uF:
C1,2	8-82905G11	0.22 ±10%; 50 V
C3	23-865137	4.7 ±20%; 25 V
C4,5	8-82905G11	0.22 ±10%; 50 V
C6	23-865137	4.7 ±20%; 25 V
		SEMICONDUCTOR DEVICE, diode:
CR1 thru 5	48-83654H01	silicon
		SWITCH, magnetic reed: 13.4 V dc
K1	80-84157B02	dual-coil; 2 form "A", 1 form "B"; resistance of each coil 285 ohms ±10%
		TRANSISTOR:
Q1,2	48-869642	NPN; type M9642
		RESISTOR, fixed: ±10%; 1/4 W:
R1	6-124C69	6.8k
R2	6-124C51	1.2k
R3	6-124C53	1.5k
R4	6-124C43	560
R5	6-124C49	1k
R6	6-124C69	6.8k
R7	6-124C83	27k
R8	6-124C93	68k
R9	6-124C43	560
R10	6-124C19	56
R11	6-124C85	33k
R12	6-124C75	12k
R13	6-124C49	1k
R14	6-124C45	680

"COMPA-STATION"
METERING & INTERCOM
MODEL TLN1740A
INTERCOM
MODEL TLN1745A

PARTS LIST

Meter Kit — PL-3415-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	21-82428B24	CAPACITOR, fixed: .01 uF +80-20%, 500 V
CR1	48-82420C03	DIODE: (SEE NOTE) silicon
J1	9-830421-	CONNECTOR, receptacle: 4-contact
M1	19-84713C01	LOUDSPEAKER: permanent: dynamic type; 3½" square 16 ohms voice coil impedance
M1	19-82125C02	METER, dc: scale: 0-50 microamperes
P102	28-82674B01	CONNECTOR, plug: test probe, BLACK
P103	28-82674B01	test probe, RED
P1	9-84221B01	contacts
R1	6-84640C01	499K ±0.5%; 1/4 W
R2	6-13756D88	100K ±1%, 1/2 W
R3	6-12633	220 ohm ±5%; 1/4 W
		SWITCH:
S1	40-83158C01	rotary; 2 section
S2, 3	40-81890A01	slide; dpdt
		NON-REFERENCED ITEMS
	5-483206	GROMMET
	35-84530C01	GRILLE, speaker
	36-8436C01	KNOB, control
	42-10217A02	STRAP, cable; 4 req'd.
	42-82143C02	CLAMP, cable
	15-83947X01	COVER; 2 req'd. (used with probe)
	30-83678X01	CABLE, 7-conductor; 42" long (used with P102)
	42-83948K01	CLIP; 2 req'd. (used with P102)
	27-83008K01	CHASSIS, meter
	51-69018	TERMINAL STRIP, 1-lug
	42-871184	CLIP, probe; 3 req'd.
	15-83009K01	COVER, meter
	42-83123P01	RETAINER, nylon; 2 req'd.
	75-838826	BUMPER, rubber; 4 req'd.

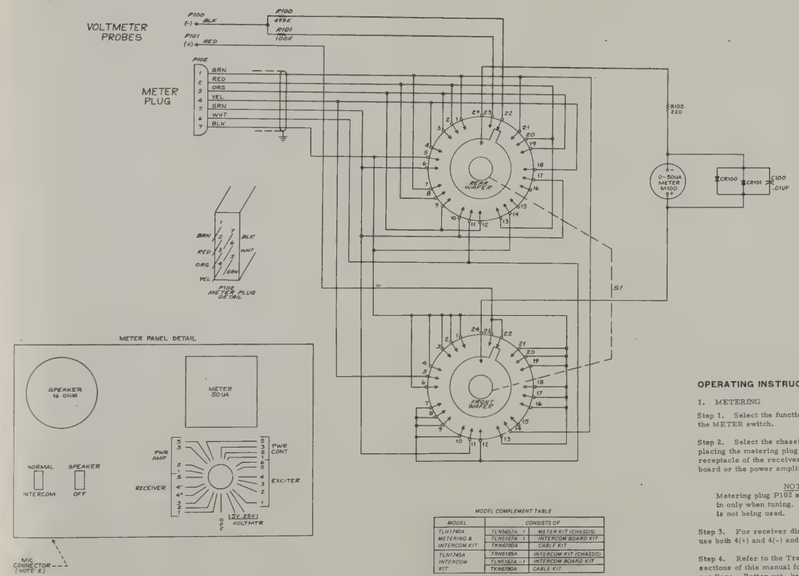
NOTE:
For optimum performance, replacement diodes must be purchased from Motorola part number.

TKN6189A Intercom Chassis Kit — PL-3452-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
T1	9-830418	CONNECTOR, receptacle: 4-contact
-	50-84710C01	SPEAKER: 3"; 16 ohm
S2, 3	40-11589	SWITCH, slide: DPST
		NON-REFERENCED ITEMS
	[illegible]	CHASSIS (riveted) incl. ref. item S2 and S3
	1-80773B01	COVER ASSEMBLY
	2-132616	LOCKNUT, speaker (No. 6-32) 4 req'd.
	2-83896C01	NUT, hex (used with J1)
	[illegible]	LOCKWASHER (used with J1)
	[illegible]	GROMMET, rubber
	[illegible]	[illegible] speaker
	[illegible]	[illegible]
	42-10217A02	TY-WRAP, cable; 4 req'd.
	1-134169	SCREW, machine; No. 4-40 x 1/4"; 7 req'd.
	[illegible]	[illegible] number 4-40 x 5/16"; 4 req'd.
	29-115147	LUG, solder (No. 5)

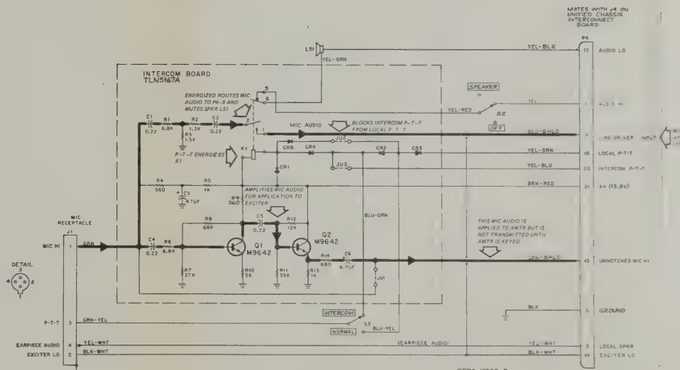
TKN6780A Cable Kit — PL-3418-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
P4	9-84151B03 14-84556B02	CONNECTOR: includes: CONTACT, receptacle; 10 req'd HOUSING
	NON-REFERENCED ITEM	
	42-10217A02	STRAP, cable harness; 7 used



MODEL COMPLEMENT TABLE

MODEL	CONSISTS OF	
TLN1740A METERING & INTERCOM KIT	TLN6502A	METER KIT (CHASSIS)
	TLN6192A	INTERCOM BOARD KIT
	TKN6189A	CABLE KIT
TLN1745A INTERCOM KIT	TLN6502A	METER KIT (CHASSIS)
	TLN6192A	INTERCOM BOARD KIT
	TKN6189A	CABLE KIT



OPERATING INSTRUCTIONS

1. METERING

Step 1. Select the function to be metered with the METER switch.

Step 2. Select the chassis to be monitored by placing the metering plug (P102) into the metering receptacle of the receiver, exciter, power control board or the power amplifier.

NOTE
Metering plug P102 should be plugged in only when tuning. Unplug it when it is not being used.

Step 3. For receiver discriminator adjustment, use both 4(+) and 4(-) and adjust for meter zero.

Step 4. Refer to the Transmitter and Receiver sections of this manual for typical or minimum readings. Better yet, keep a log of all meter readings each time the station is serviced. Use the last set of readings as a reference and note any degradation in performance.

Step 5. To measure miscellaneous station voltages, use the voltmeter probes (P100 and P101) on either the 5 V or 25 V positions. Divide the 5 V full scale reading by 10 to obtain actual voltage and divide the 25 V full scale reading by 2 to obtain actual voltage.

2. INTERCOM

Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER-OFF switch in the SPEAKER position.

Step 3. Place the NORMAL-INTERCOM switch in the INTERCOM position.

Step 4. The unit is now ready for intercom operation between the station and the remote control point. Close the PUSH-TO-TALK switch on the microphone and speak into the microphone to send a message. Release the button to listen; replies will be heard in the speaker. The console operator at the remote point must also switch to an intercom mode to prevent keying the station during replies.

Step 5. Return the SPEAKER-OFF switch to the OFF position before leaving the station unattended.

3. "ON-THE-AIR" TESTING

Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER-OFF switch in the SPEAKER position.

Step 3. Place the NORMAL-INTERCOM switch in the NORMAL position.

Step 4. The unit is now ready for "ON-THE-AIR" testing. If the microphone PUSH-TO-TALK switch is closed, the station's transmitter will be keyed. Speak into the microphone to transmit a message. Release the PUSH-TO-TALK switch to listen. Receiver audio will be heard on the speaker.

Step 5. Return the SPEAKER-OFF switch to OFF before leaving the station unattended.

4. MONITORING

To monitor audio quality, etc., place the SPEAKER-OFF switch in the SPEAKER position. Both receiver audio and line audio from the remote control point will be heard in the speaker.

FUNCTION

--Model TLN1740A provides built-in metering of over 20 major test points in the transmitter and receiver(s), plus intercom between the station and the remote control point.

--Model TLN1745A provides intercom between the station and the remote control point.

METER SELECT TABLE

P102 METERING PLUG CONNECTED TO	METER SELECTOR SW. WITH NO.	POSITION	FUNCTION METERED
RCVR RF & IF BOARD	RECEIVER	1	1 CHANNEL ELEMENT OUTPUT (3RD HARMONIC)
		2	2 1ST DOUBLER OUTPUT
		3	3 2ND DOUBLER OUTPUT
		4	4 1ST MIXER OUTPUT
		5	5 2ND MIXER OUTPUT
		6	6 LIMITER OUTPUT
POWER AMPLIFIER	PWR AMP	1	1 RF OUTPUT
		2	2 RF OUTPUT (1-4 MODEL ONLY)
		3	3 DRIVER OUTPUT (1-4 MODEL ONLY)
		4	4 FINAL AMPLIFIER CURRENT
POWER CONTROL BOARD	PWR CONT	1	1 FINAL AMPLIFIER VOLTAGE (1-4 MODEL ONLY)
		2	2 ADJ. VOLTAGE
		3	3 REFLECTED POWER
		4	4 FORWARD POWER
EXCITER	EXCITER	6	6 UNUSED
		5	5 UNUSED
		4	4 EXCITER OUTPUT
		3	3 -5V REGULATOR
		2	2 +5V REGULATOR
		1	1 CHANNEL ELEMENT OUTPUT
		21	21 +20V AUDIO OUTPUT
		22	22 25 VOLTS FULL SCALE (NOTE: METER IS LABELLED 0-50)
		23	23 5 VOLTS FULL SCALE
		24	24 OFF

NOTE
WITH 12 W STATIONS, FINAL PA CURRENT IS METERED AT PWR CONT MTR'S. WITH ALL OTHER STATIONS, FINAL PA CURRENT IS METERED AT PA MTR'S.

NOTE
1. THIS OPTION REQUIRES THE USE OF A MOTOROLA MODEL TKN6017A MICROPHONE, OR EQUIVALENT

JUMPER TABLE

JUMPER	NORMAL	MONITORING (NOTE 1)
J101-A	J101-B	J101-C
J102-A	J102-B	J102-C
J103-A	J103-B	J103-C

LEGEND
- THEORY OF OPERATION DATA
- PA MARKING CALL FLOW

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TRN6189A Intercom Chassis Kit — PL-3415-A

	21-[illegible]B24	CAPACITOR, fixed: .01 µF ±80-20%, 500 V
	4[illegible]82420C03	DIODE: (SEE NOTE) silicon
	9-830418	CONNECTOR, receptacle: 4-contact
	50-84710G01	LOUDSPEAKER, permanent: dynamic type; 3" square 16 ohms voice coil impedance
	72-83120C02	METER, dc: scale: 0-50 microamperes
	29-82676C01 29-82676C02 28-84208B01	CONNECTOR, plug: test probe; BLACK test probe; RED 7-contacts
	[illegible]	RESISTOR, fixed: 499k ±0.5%; 1/4 W 100k ±1%; 1/2 W 220 ohm ±5%; 1/4 W
	40-83158C01 [illegible]83890A01	SWITCH: rotary: 2 section slide: dpdt

NON-REFERENCED ITEMS

5-483208	GROMMET
35-84530G01	GRILLE, speaker
36-84356C01	KNOB, control
42-10217A02	STRAP, cable; 4 req'd.
42-82143C02	CLAMP, cable
15-83947K01	COVER; 2 req'd. (used with P102)
30-83678K01	CABLE, 7-conductor; 42" long (used with P102)
42-83948K01	CLIP; 2 req'd. (used with P102)
27-83008K01	CHASSIS, meter
31-490181	TERMINAL STRIP, 1-lug
42-87184	CLIP, probe; 3 req'd.
15-83009K01	COVER, meter
42-83173P01	RETAINER, nylon; 2 req'd.
75-8382c	BUMPER, rubber; 4 req'd.

Maximum performance, replacement diodes must be ordered by Motorola part number.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TRN6189A Intercom Chassis Kit — PL-3452-O

	9-830418	CONNECTOR, receptacle: 4-contact
	50-84710G01	LOUDSPEAKER: 3"; 16 ohm
	48-11589	SWITCH, slide: DPST

NON-REFERENCED ITEMS

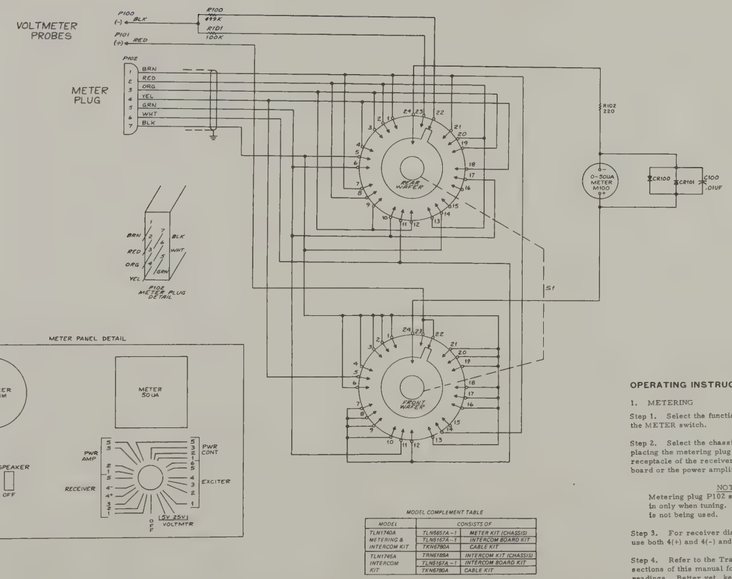
	1-80775B59	CHASSIS (riveted) incl. ref. item S2 and S3
	[illegible]	COVER ASSEMBLY
	[illegible]	LOCKNUT, speaker (No. 6-32) 4 req'd.
	[illegible]	NUT, hex (used with J1)
	[illegible]	LOCKWASHER (used with J1)
	[illegible]	GROMMET, rubber
	[illegible]	GRILLE, speaker
	[illegible]	CLAMP, cable (1/4")
	[illegible]	TY-WRAP, cable; 4 req'd.
	1-129498	SCREW, machine; No. 6-32 x 5/16"; 4 req'd.
	29-115147	LUG, solder (No. 5)

TKN6780A Cable Kit — PL-3418-A

P4	- 9-84151B03 14-84556B02	CONNECTOR: includes: CONTACT, receptacle; 10 req'd HOUSING

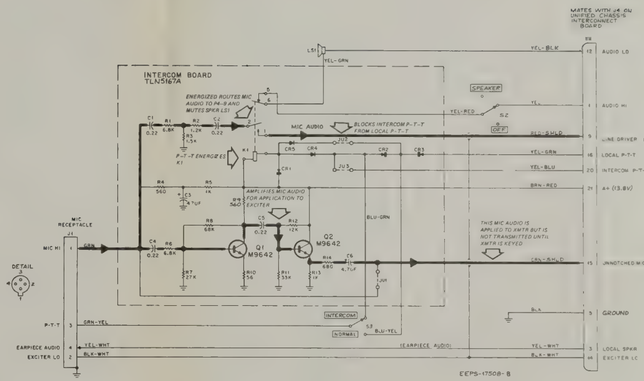
NON-REFERENCED ITEM

	42-10217A02	STRAP, cable harness; 7 used



MODEL COMPLEMENT TABLE

MODEL	CONSISTS OF	
TLN1740A METERING & INTERCOM KIT	TLN6557A-1 TLN6157A-1 TKN6780A	METER KIT (CHASSIS) INTERCOM BOARD KIT CABLE KIT
TLN1745A INTERCOM KIT	TKN6189A TLN6157A-1 TKN6780A	INTERCOM KIT (CHASSIS) INTERCOM BOARD KIT CABLE KIT



OPERATING INSTRUCTIONS

1. METERING

Step 1. Select the function to be metered with the METER switch.

Step 2. Select the chassis to be monitored by placing the metering plug (P102) into the metering receptacle of the receiver, exciter, power control board or the power amplifier.

NOTE

Metering plug P102 should be plugged in only when tuning. Unplug it when it is not being used.

Step 3. For receiver discriminator adjustment, use both 4(+) and 4(-) and adjust for meter zero.

Step 4. Refer to the Transmitter and Receiver sections of this manual for typical or minimum readings. Better yet, keep a log of all meter readings each time the station is serviced. Use the last set of readings as a reference and note any degradation in performance.

Step 5. To measure miscellaneous station voltages, use the voltmeter probes (P100 and P101) on either the 5 V or 25 V positions. Divide the 5 V full scale reading by 10 to obtain actual voltage and divide the 25 V full scale reading by 2 to obtain actual voltage.

2. INTERCOM

Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER-OFF switch in the SPEAKER position.

Step 3. Place the NORMAL-INTERCOM switch in the INTERCOM position.

Step 4. The unit is now ready for intercom operation between the station and the remote control point. Close the PUSH-TO-TALK switch on the microphone and speak into the microphone to send a message. Release the button to listen; replies will be heard in the speaker. The console operator at the remote point must also switch to an intercom mode to prevent keying the station during replies.

Step 5. Return the SPEAKER-OFF switch to the OFF position before leaving the station unattended.

3. "ON-THE-AIR" TESTING

Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER-OFF switch in the SPEAKER position.

Step 3. Place the NORMAL-INTERCOM switch in the NORMAL position.

Step 4. The unit is now ready for "ON-THE-AIR" testing. If the microphone PUSH-TO-TALK switch is closed, the station's transmitter will be keyed. Speak into the microphone to transmit a message. Release the PUSH-TO-TALK switch to listen. Receiver audio will be heard on the speaker.

Step 5. Return the SPEAKER-OFF switch to OFF before leaving the station unattended.

4. MONITORING

To monitor audio quality, etc., place the SPEAKER-OFF switch in the SPEAKER position. Both receiver audio and line audio from the remote control point will be heard in the speaker.

"COMPA-STATION" METERING & INTERCOM

MODEL TLN1740A

INTERCOM

MODEL TLN1745A

FUNCTION

--Model TLN1740A provides built-in metering of over 20 major test points in the transmitter and receiver(s), plus intercom between the station and the remote control point.

--Model TLN1745A provides intercom between the station and the remote control point.

METER SELECT TABLE

P102 METERING PLUG CONNECTED TO	METER SELECTOR SW		FUNCTION METERED
	METER	POSITION	
RECEIVER	RECEIVER	1	CHANNEL ELEMENT OUTPUT (3RD HARMONIC)
		2	1ST DOUBLER OUTPUT
		3	2ND DOUBLER OUTPUT
		4	DISCRIMINATOR OUTPUT
		5	AUDIO OUTPUT
		6	LIMITER OUTPUT
POWER AMPLIFIER	PWR AMP	1	PA EXCITER CURRENT
		2	28 W DRIVER CURRENT (75 W MODEL ONLY)
		3	FINAL AMPLIFIER CURRENT (EXCEPT 12 W STATIONS)
		5	CONTROLLED ADJ. STAGE VOLTAGE
		10	FINAL AMPLIFIER CURRENT (12 W STATIONS ONLY)
POWER CONTROL BOARD	PWR CONT	1	ADJ. VOLTAGE
		2	REFLECTED POWER
		4	FORWARD POWER
EXCITER	EXCITER	1	AFC
		2	EXCITER OUTPUT
		3	1ST DOUBLER OUTPUT
		4	DOUBLER INPUT
		5	FREQUENCY
		6	CHANNEL ELEMENT OUTPUT
		7	HIGH AUDIO INPUT
		8	28 VOLT FULL SCALE
		9	5 VOLT FULL SCALE
		10	SPARE

NOTE: METER IS LABELLED 0-50

NOTE

WITH 12 W STATIONS FINAL PA CURRENT IS METERED AT PWR CONT MTR'S WITH ALL OTHER STATIONS FINAL PA CURRENT IS METERED AT PA MTR.

NOTE

1 THIS OPTION REQUIRES THE USE OF A MOTOROLA MODEL "MINETTA MICROPHONE OR EQUIVALENT

JUMPER TABLE

JUMPER	SIGNAL	WHEN SPECTRA TAC IS ADDED, ADJ TO:

LEGEND

THEORY OF OPERATION DATA

PRIMARY SIGNAL FLOW

POWER SUPPLY

MODELS TPN1110A

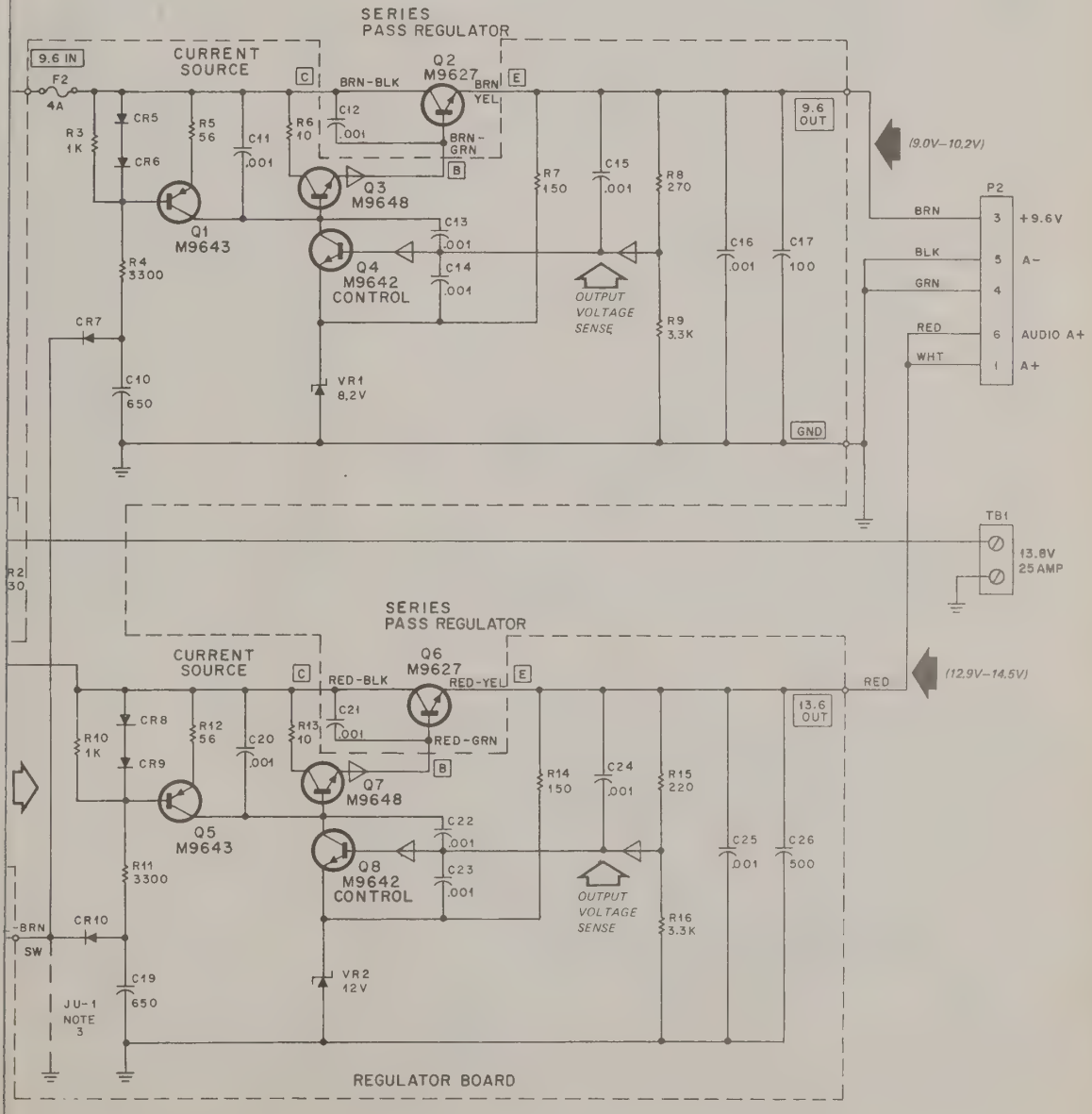
TPN1110B

FUNCTION –

Provides regulated 9.6 V dc and 13.6 V dc outputs and a 13.8 V dc unregulated output from a 121 V 60 Hz ac power input. 9.6 V and 13.6 V outputs are automatically adjusted for changes in load or input voltage.

MODEL COMPLEMENT

Model	Version	Chassis & Hardware	Version	Regulator Board	Version	Cable
TPN1110A		TLN5123A		TLN5122A		TKN6658A
TPN1110B		TLN5123B		TLN5122A		TKN6658A

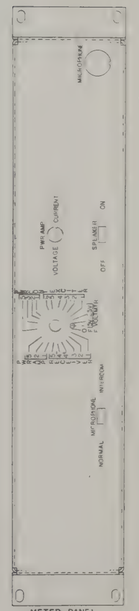


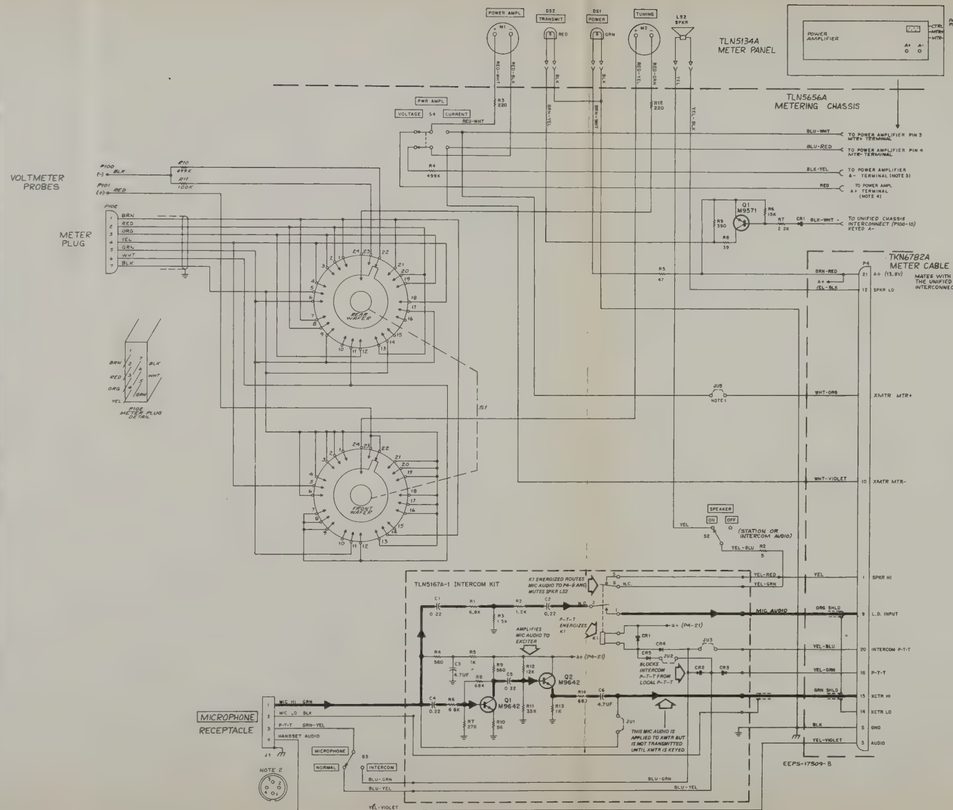
UPRIGHT STATION METERING & INTERCOM

MODELS TLN1739A AND TLN5134A

FUNCTION

Provides built-in metering of over 20 major test points in the transmitter and receiver(s). Plus intercom between the station and the remote control point.





OPERATING INSTRUCTIONS

1. METERING

Step 1. Tuning Meter Usage -- Select the function to be metered with the meter switch. Next, select the chassis to be monitored by placing the metering plug (P102) into the metering receptacle of the receiver, exciter, power control board, or the power amplifier. NOTE: Metering plug P102 should be plugged in only when tuning. Unplug it when it is not being used. For receiver discriminator adjustment, use both 4(+) and 4(-) and adjust for meter zero.

Step 2. PWR AMP Meter Usage -- Select PA current/voltage monitoring by placing the VOLTAGE/CURRENT switch in the applicable position.

Step 3. Refer to the Transmitter and Receiver sections of this manual for typical or minimum readings. Better yet, keep a log of all meter readings each time the station is serviced. Use the last set of readings as a reference and note any degradation in performance.

Step 4. Voltmeter Usage -- Use either the 5 V or 25 V scales as applicable. Divide the 5 V full scale reading by 10 to obtain actual voltage. Divide the 25 V full scale reading by 2 to obtain actual voltage.

2. INTERCOM

Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER switch in the ON position.

Step 3. Place the NORMAL-INTERCOM switch in the INTERCOM position.

Step 4. The unit is now ready for intercom operation between the station and the remote control point. Close the PUSH-TO-TALK switch on the microphone and speak into the microphone to send a message. Release the button to listen; replies will be heard in the speaker. The console operator at the remote point must also switch to an intercom mode to prevent keying the station during replies.

Step 5. Return the SPEAKER switch to the OFF position before leaving the station unattended.

3. "ON-THE-AIR" TESTING

Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER switch in the ON position.

Step 3. Place the NORMAL-INTERCOM in the NORMAL position.

Step 4. The unit is now ready for "on-the-air" testing. If the microphone PUSH-TO-TALK switch is closed, the station's transmitter will be keyed. Speak into the microphone to transmit a message. Release the PUSH-TO-TALK switch to listen. Receiver audio will be heard on the speaker.

Step 5. Return the SPEAKER switch to OFF before leaving the station unattended.

4. MONITORING

To monitor audio quality, etc. place the SPEAKER switch in the ON position. Both receiver audio and line audio from the remote control point will be heard in the speaker.

MODEL COMPLEMENT TABLE

MODEL	CONSISTS OF
TLN1739A METERING CHASSIS	TLN5656A METERING CHASSIS
TLN5134A METER PANEL	TLN5167A INTERCOM BOARD KIT TKN6782A CABLE KIT

METER SELECT TABLE

PWB METERING PLUG CONNECTED TO	METER SELECTOR SW		FUNCTION METERED
	MTR NO	POSITION	
MAIN RF & IF BOARD	RECEIVER 1	1	CHANNEL ELEMENT OUTPUT (3RD HARMONIC)
		2	1ST DOUBLER OUTPUT
		3	2ND DOUBLER OUTPUT
		4 (+)	5VDC REGULATOR OUTPUT
		4 (-)	5VDC REGULATOR OUTPUT
		5	+METER (5/25 V)
		6	FINAL AMPLIFIER CURRENT
POWER AMPLIFIER	PA	7	PA CURRENT (CURRENT IN W MODEL ONLY)
		8	CONTROLLED ADJ. STAGE VOLTAGE
		9	+METER (5/25 V)
POWER CONTROL BOARD	PWR CONTROL BOARD	10	FINAL AMPLIFIER CURRENT (12 W STATIONS ONLY)
		11	ADJ. VOLTAGE
		12	REFLECTED POWER
		13	FORWARD POWER
EXCITER	EXCTR	14	UNUSED
		15	UNUSED
		16	EXCITER OUTPUT
		17	DOUBLER INPUT
		18	TRIPLER INPUT
		19	CHANNEL ELEMENT OUTPUT
		20	VCC AUDIO OUTPUT
—	—	21	25 VOLTS FULL SCALE METER IS CALIBRATED FOR
—	—	22	5 VOLTS FULL SCALE CAMELOT-50
—	—	23	OFF

NOTES

1. J6/J8 -- III FOR 12 W MODELS, OUT FOR ALL OTHER MODELS
2. INTERCOM REQUIRES THE USE OF A MOTOROLA MODEL TMN6577A MICROPHONE OR EQUIVALENT
3. ON 12-WATT STATIONS, BLK-YEL (#14) LEAD IS CONNECTED TO TB2-7 (-) ON UNIFIED CHASSIS INTER CONNECT BOARD
4. ON 25-WATT STATIONS, RED (#14) LEAD IS CONNECTED TO TB2-11 (+) ON UNIFIED CHASSIS INTERCONNECT BOARD

LEGEND

- THEORY OF OPERATION DATA
- PRIMARY SIGNAL FLOW

PARTS LIST

TLN5656A Metering Kit — PL-3416-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
CR1	48-82392B03	DIODE: (SEE NOTE) silicon
J1	9-830418	CONNECTOR, receptacle: 4-contact
Q1	48-869571	TRANSISTOR: (SEE NOTE) PNP: type M9571
P100	29-82676C01	CONNECTOR, plug: test probe; BLACK
P101	29-82676C02	test probe; RED
P102	28-84208B01	7-contact
R1		RESISTOR, fixed: ±10%; 1/2 W unless otherwise stated NOT USED
R2	17-82177B04	5; 5 W
R3	6-124A33	220
R4, 10	6-84640C61	499k ±1%
R5	6-125C17	47
R6	6-124A77	15k ±5%; 1/4 W
R7	6-124A57	2.2k ±5%; 1/4 W
R8	6-125C15	39
R9	6-125A39	390
R11	6-12756D88	100k ±1%
R12	6-125A33	220 ±5%
S1	40-83158C01	SWITCH: rotary; 2 section
S2, 3	40-83890A01	slide; dpdt
S4	40-811751	toggle; dpdt
		NON-REFERENCED ITEMS
	42-890499	CLAMP, cable; 1/2"
	36-82630H01	KNOB, control
	31-490181	TERMINAL STRIP, 1-lug: 2 req'd.
	42-871184	CLIP, probe; 3 req'd.
	30-83678K01	CABLE, 7-conductor; 57" long (used with P102)
	15-83947K01	COVER: 2 req'd. (used with P102)
	42-83948K01	CLAMP, cable; 2 req'd.
	31-835961	TERMINAL BOARD, 18-lug
	27-83409K01	CHASSIS

NOTE:
For optimum performance, replacement diodes and transistors must be ordered by Motorola part number.

TKN6782A Cable Kit — PL-3417-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
J4	9-84151B03 14-84956B02	CONNECTOR: Includes: CONTACT, receptacle: 12 req'd. HOUSING

TLN5134A Meter Panel — PL-2233-A

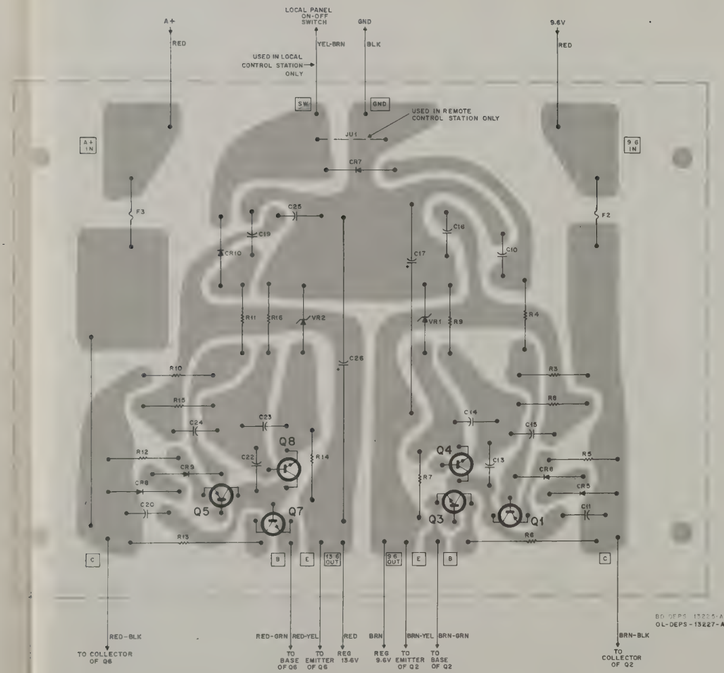
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
DS1 DS2	65-83183D02 65-83183C04	LIGHT, indicator: includes lamp and GRN lens includes lamp and RED lens
LS1	48-[illegible]A01	LOUDSPEAKER, permanent magnet: dynamic type; 4"; square; 4 ohms voice coil impedance
M1	72-84864B10 72-84864B09	METER, electrical: 50 uA Includes: scale: 0-5 volts/amps scale: 0-50 microamperes
		NON-REFERENCED ITEMS
	13-84614C01	GRILLE, speaker
	13-83207F01	CLOTH, speaker grille
	42-83112A01	CLIP, indicator light retaining: 4 used
	2-7009	NUT, hex: 10-32 x 3/8 x 1/8"; 4 used
	3-11991n	SCREW, machine: 10-32 x 7/16"; 4 used
	3-131964	SCREW, tapping: 6-32 x 3/8; 12 used
	4-7658	WASHER, lock: #10 (split); 4 used
	7-84620G01	FRAME, top
	7-84620G03	FRAME, bottom
	7-84620G05	FRAME, end; 2 used
	13-83054C10	GRILLE, meter panel
	64-83152C03	PANEL, meter

FUNCTION –

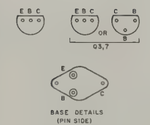
Provides regulated 9.6 V dc and 13.6 V dc outputs and a 13.8 V dc unregulated output from a 121 V 60 Hz ac power input. 9.6 V and 13.6 V outputs are automatically adjusted for changes in load or input voltage.

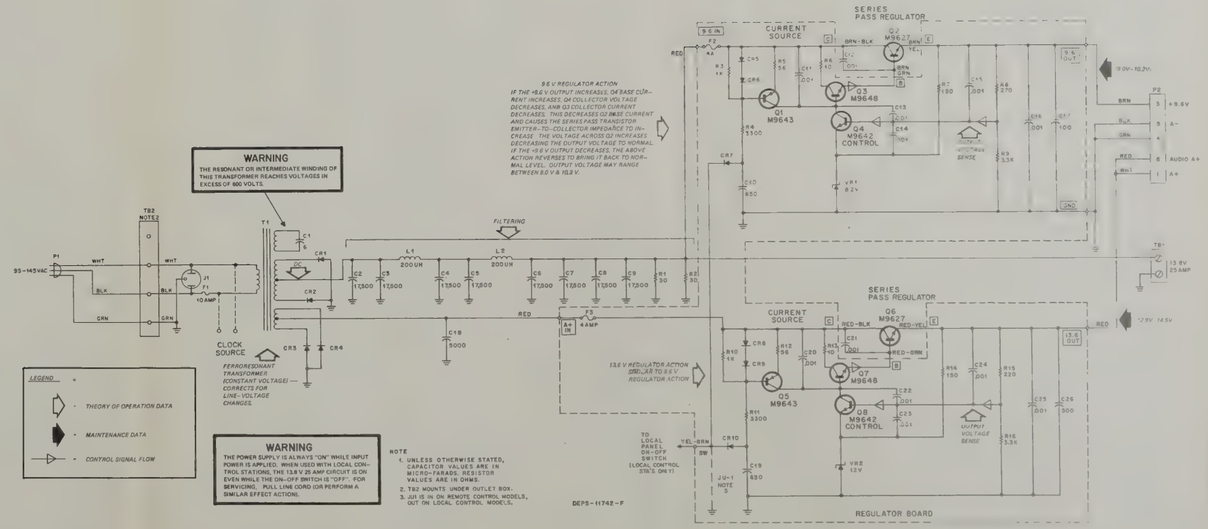
MODEL COMPLEMENT

Model	Version	Chassis Hardware	Version	Regulator Board	Version	Transformer
TPN1110A		TLN5123A		TLN5122A		TKN6n58A
TPN1110B		TLN5123B		TLN5122A		TKN6n58A



SHOWN FROM COMPONENT SIDE
9.6V AND 13.6V REGULATOR BOARD




WARNING
THE RESONANT OR INTERMEDIATE WINDING OF THIS TRANSFORMER REACHES VOLTAGES IN EXCESS OF 600 VOLTS.
TB2 NOTE2
T1
P1
95-145VAC
WHT
BLK
GRN
J1
F1
10 AMP
CLOCK SOURCE
FERRORESONANT TRANSFORMER (CONSTANT VOLTAGE) — CORRECTS FOR LINE-VOLTAGE CHANGES.
CR3
CR4
C1
CR1
CR2
FILTERING
L1
200 UH
L2
200UH
C2
C3
C4
C5
C6
C7
C8
C9
R1
R2
17,500
5000
30
35
RED
F3
4 AMP
A4 IN
9.6 V REGULATOR ACTION
IF THE +9.6 V OUTPUT INCREASES, OR BASE CURRENT INCREASES, OR COLLECTOR VOLTAGE DECREASES, AND Q3 COLLECTOR CURRENT DECREASES. THIS DECREASES Q2 BASE CURRENT AND CAUSES THE SERIES-PASS TRANSISTOR EMITTER-TO-COLLECTOR IMPEDANCE TO INCREASE. THE VOLTAGE ACROSS Q2 INCREASES DECREASING THE OUTPUT VOLTAGE TO NORMAL. IF THE +9.6 V OUTPUT DECREASES, THE ABOVE ACTION REVERSES TO BRING IT BACK TO NORMAL LEVEL. OUTPUT VOLTAGE MAY RANGE BETWEEN 8.0 V & 10.2 V.
SERIES PASS REGULATOR
CURRENT SOURCE
Q2 M9627
Q1 M9643
Q3 M9648
Q4 M9642 CONTROL
OUTPUT VOLTAGE SENSE
9.6 OUT
9.0V-10.2V
P2
+9.6V
A-
AUDIO A4
A+
J2
J3
J4
J5
J6
J7
J8
J9
J10
J11
J12
J13
J14
J15
J16
J17
J18
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J22
J23
J24
J25
J26
J27
J28
J29
J30
J31
J32
J33
J34
J35
J36
J37
J38
J39
J40
J41

PARTS LIST

TLN5122A Power Supply Board PL-2420-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; 100 V unless otherwise stated
C10	21-848236	650 pF ±5%; 300 V
C11	21-82187B20	.001
C13 thru 16	21-82187B20	.001
C17	23-82601A25	100 -10+150%; 20 V
C19	21-848236	650 pF ±5%; 300 V
C20	21-82187B20	.001
C22 thru 25	21-82187B20	.001
C26	23-83210A19	500 -10+100%; 20 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR5 thru 10	48-83654H01	Silicon
		TRANSISTOR: (SEE NOTE)
Q1	48-869643	PNP; type M9643
Q3	48-869648	NPN; type M9648
Q4	48-869642	NPN; type M9642
Q5	48-869643	PNP; type M9643
Q7	48-869648	NPN; type M9648
Q8	48-869642	NPN; type M9642
		RESISTOR, fixed: ±10%; 1/4 W unless otherwise stated
R3	6-10401C49	1k
R4	6-10401C61	3.3k
R5	6-10401C19	56
R6	6-488022	10; 1 W
R7	6-10401C29	150
R8	6-10401A35	270 ±5%
R9	6-10401A61	3.3k ±5%
R10	6-10401C49	1k
R11	6-10401C61	3.3k
R12	6-10401C19	56
R13	6-488022	10; 1 W
R14	6-10401C29	150
R15	6-10401A33	220 ±5%
R16	6-10401A61	3.3k ±5%
		SEMICONDUCTOR DEVICE, (SEE NOTE)
VR1	48-82256C08	Zener, 8.2 V
VR2	48-82256C25	Zener, 12 V
		NON-REFERENCED ITEM
	42-82690A01	CLIP, fuse; 4 req'd.

TKN6658A Cable Kit PL-2421-A

P2	⊣[	9-84151B01	CONTACT, receptacle; 5 req'd.
		14-84590B01	INSULATOR, connector
		42-10217A02	STRAP, cable; 6 req'd.

NOTE:
For optimum performance, diode and transistor replacement parts must be ordered by Motorola part number only.

TLN5123B Chassis and Hardware Kit (P/O TPN1110B)
TLN5123A Chassis and Hardware Kit (P/O TPN1110A) PL-2417-D

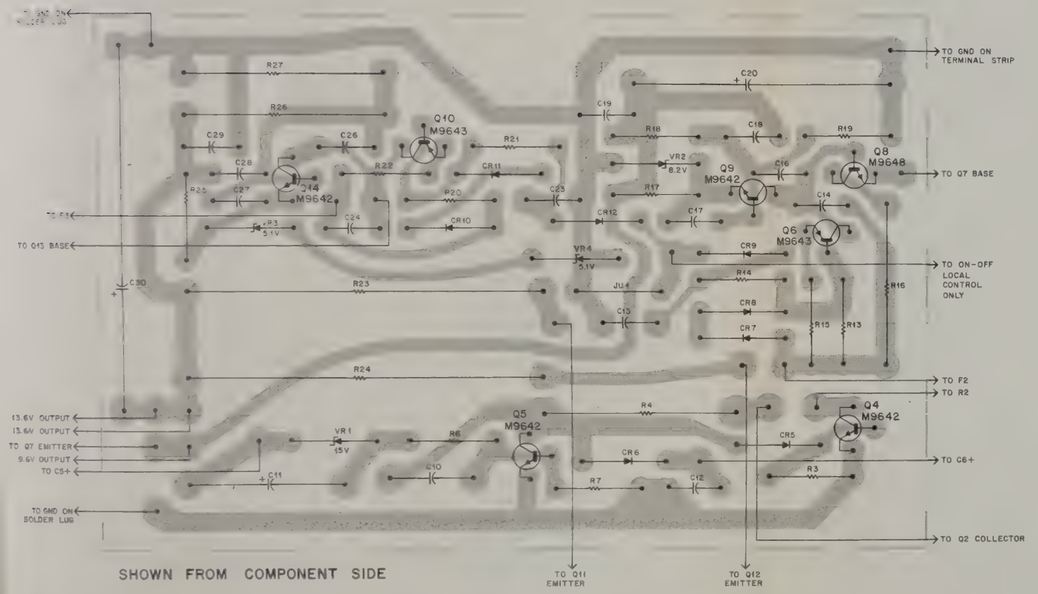
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; 100 V unless otherwise stated
C1	8-84717G01	6; 660 V
C2 thru 9	23-83093G20	17,500 +150-10%; 20 V
C12	21-82187B14	.001
C18	23-82304B16	5000 -10+150%; 35 V
C21	21-82187B14	.001
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1, 2	1-80739B57	Assembly, silicon
CR3, 4	48-82525G13	silicon
		FUSE, cartridge:
F1	65-138179	10 A, 125 V
F2, 3	65-61688	4A, 250 V
		CONNECTOR, receptacle:
J1	9-83238C01	3 prong
		CHOKE, filter:
L1, 2	25-84514G01	200 uh
		TRANSISTOR: (SEE NOTE)
Q2	48-869627	NPN; type M9627
Q6	48-869627	NPN; type M9627
		RESISTOR, fixed:
R1, 2	17-83389G02	30 ±5%; 20 W
		TRANSFORMER, power:
T1	25-84516G01	primary windings 1 & 2; 3 secondary windings 3 & 5 with 4 center top, 6 & 8 with 7 center top, and 9 & 10
		NON-REFERENCED ITEMS
	14-865854	INSULATOR, transistor; 2 req'd
	5-84512G01	GROMMET; 4 req'd.
	9-82083C01	FUSEHOLDER, extractor post type
	14-84548A01	INSULATOR, diode; 2 req'd.
	37-107234	GROMMET, rubber
	9-84935D01	SOCKET, transistor; 2 req'd.
	64-83562D01	HEAT SINK; 2 req'd.
	30-83211C01	AC LINE CORD; includes molded plug (P1)
	14-82975K01	INSULATOR

POWER SUPPLY

MODELS TPN1151A AND TPN1152A

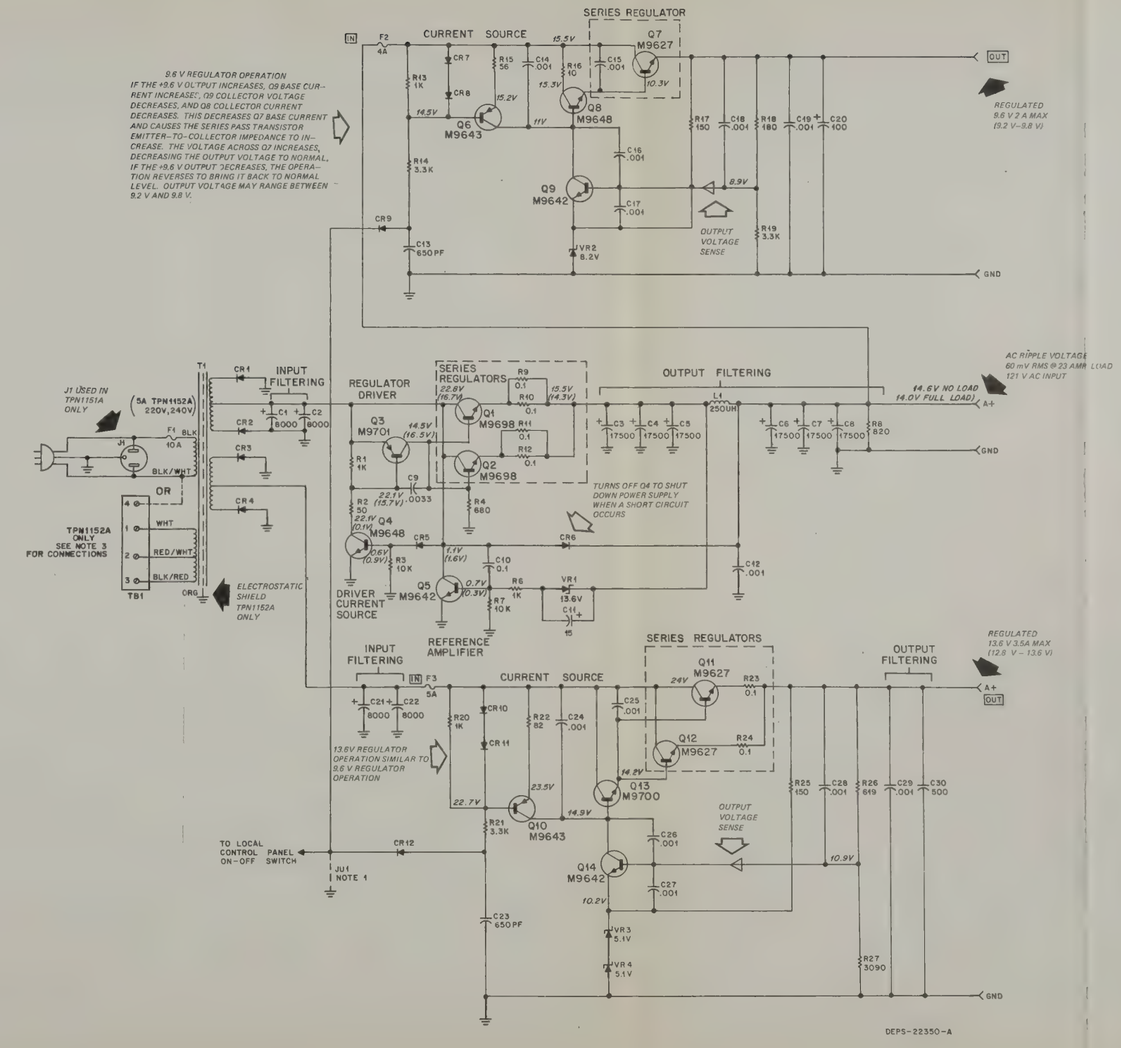
FUNCTION-

Provides regulated 9.6 V dc and two 13.6 V dc outputs from a 120 V, 60 Hz (TPN1151A), or 120, 220, 240 V, 50/60 Hz (TPN1152A) power input. All outputs are automatically adjusted for changes in load or input voltage.



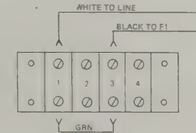
SHOWN FROM COMPONENT SIDE

BD-CEPS-22351-O
OL-CEPS-22352-O


9.6 V REGULATOR OPERATION
IF THE +9.6 V OUTPUT INCREASES, Q9 BASE CURRENT INCREASES, Q9 COLLECTOR VOLTAGE DECREASES, AND Q8 COLLECTOR CURRENT DECREASES. THIS DECREASES Q7 BASE CURRENT AND CAUSES THE SERIES PASS TRANSISTOR EMITTER-TO-COLLECTOR IMPEDANCE TO INCREASE. THE VOLTAGE ACROSS Q7 INCREASES, DECREASING THE OUTPUT VOLTAGE TO NORMAL. IF THE +9.6 V OUTPUT DECREASES, THE OPERATION REVERSES TO BRING IT BACK TO NORMAL LEVEL. OUTPUT VOLTAGE MAY RANGE BETWEEN 9.2 V AND 9.8 V.
SERIES REGULATOR
CURRENT SOURCE
REGULATED 9.6 V 2 A MAX (9.2 V–9.8 V)
OUTPUT VOLTAGE SENSE
J1 USED IN TPN1151A ONLY
(5A TPN1152A) 220V,240V
10A
TPN1152A ONLY SEE NOTE 3 FOR CONNECTIONS
ELECTROSTATIC SHIELD TPN1152A ONLY
INPUT FILTERING
REGULATOR DRIVER
SERIES REGULATORS
OUTPUT FILTERING
AC RIPPLE VOLTAGE 60 mV RMS @ 23 AMP LOAD 121 V AC INPUT
14.6V NO LOAD 14.0V FULL LOAD
TURNS OFF Q4 TO SHUT DOWN POWER SUPPLY WHEN A SHORT CIRCUIT OCCURS
DRIVER CURRENT SOURCE
REFERENCE AMPLIFIER
13.6V REGULATOR OPERATION SIMILAR TO 9.6 V REGULATOR OPERATION
TO LOCAL CONTROL PANEL ON-OFF SWITCH
REGULATED 13.6 V 3.5A MAX (12.8 V – 13.6 V)
DEPS-22350-A

NOTES

1. GND IS SIGNAL GROUND ON REMOTE CONTROL MODELS. OUT ON LOCAL CONTROL MODELS.
2. UNLESS OTHERWISE STATED, CAPACITOR VALUES ARE IN MICROFARADS. RESISTOR VALUES ARE IN OHMS.
3. TPN1151A – 60 Hz 120 V AC SHOWN)
   TPN1152A – 50/60 Hz 120, 220, 240 V AC (CONNECTIONS AS FOLLOWS)



CONNECTIONS FOR 120 V AC: GRN JUMPER FROM TB1–1 TO TB1–4
WHITE LEAD TO TB1–4
BLACK LEAD TO TB1–3

220 V AC: GREEN JUMPER FROM TB1–3 TO TB1–4
WHITE LEAD TO TB1–2
BLACK LEAD NOT USED, REMOVE

240 V AC: GREEN JUMPER FROM TB1–3 TO TB1–4
WHITE TO TB1–1
BLACK NOT USED, REMOVE

PARTS LIST SHOWN ON BACK OF PAGE

68P81033F41-A
1/4/77-UP

TAB 1. DESCRIPTION

TAB 2. INSTALLATION

TAB 3. STATION MAINT
POWER SUPPLY

STATION MAINTENANCE
MAINTENANCE LOG SHEET
METERING & INTERCOM
POWER SUPPLY

TAB 4. TRANSMITTER

ALIGNMENT
MAINTENANCE
INTERCONNECT BOARD
EXCITER/1ST BANDPASS FILTER
POWER AMPLIFIERS
POWER CONTROL BOARD/
ANTENNA NETWORK/CONTROL STAGE
"PRIVATE–LINE" ENCODERS

TAB 5. RECEIVER

ALIGNMENT
MAINTENANCE
INTERCONNECT BOARD
RF & IF
AUDIO & SQUELCH
"PRIVATE–LINE" DECODERS

TRN6717A Power Supply Board PL-5033-A

		CAPACITORS, fixed, uf unless otherwise stated
C10	8-82905G30	0.1; ±10%; 50 V
C11	23-83214C02	15; ±20%; 20 V
C12	21-82187B14	.001; ±10%; 100 V
C13	21-848236	650 pF; ±5%; 300 V
C14 thru 19	21-82187B14	.001; ±10%; 100 V
C20	23-82601A25	100; -10+150%; 100 V
C23	21-848236	650; ±5%; 300 V
C24	21-82187B14	.001; ±10%; 100 V
C26 thru 29	21-82187B14	.001; ±10%; 100 V
		DIODES: (SEE NOTE)
CR5 thru 12	48-83654H01	silicon
		TRANSISTORS: (SEE NOTE)
Q4	48-869648	NPN; type M9648
Q5	48-869642	NPN; type M9642
Q6	48-869643	PNP; type M9643
Q8	48-869648	NPN; type M9648
Q9	48-869642	NPN; type M9642
Q10	48-869643	PNP; type M9643
		RESISTORS, fixed; ±10%, 1/4 W; unless otherwise stated
R3	6-124C73	10k
R4	6-127C45	680; 2 W
R5, 6	6-124C49	1k
R7	6-124C73	10k
R13	6-124C49	1k
R14	6-124C61	3.3k
R15	6-124C19	56
R16	6-126C01	10
R17	6-124C29	150
R18	6-124A31	180 ±5%
R19	6-124C61	3.3k
R21	6-124A61	3.3k ±5%
R22	6-124C23	82k
R23, 24	17-82177B50	.1; 7 W
R25	6-124C29	150
R27	6-82672B36	3090 ±1%
		VOLTAGE REGULATORS: (SEE NOTE)
VR1	48-82256C65	zener, 13.6 V
VR2	48-83461E32	zener, 8.2 V
VR3, 4	48-83461E23	zener, 5.1 V
		MECHANICAL PARTS
	1-80791B25	CIRCUIT BOARD, eyeleted includes:
	43-84594G01	STANDOFF

NOTE:

For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TRN6718A Power Supply Chassis (60 Hz)
TRN6731A Power Supply Chassis (50 Hz) PL-5034-A

		CAPACITORS: fixed; uF unless otherwise stated
C1, 2	23-83093G13	8000; +150-10%; 35 V
C3 thru 8	23-83093G20	17500; +150-10%; 20 V
C9	21-82428B10	.0033; ±10%; 100 V
C21, 22	23-83093G13	8000; +150-10%; 35 V
C25	21-82187B14	.001; ±10%; 100 V
		DIODES: (SEE NOTE)
CR1, 2	01-80739B59	silicon
CR3, 4	48-82525G13	silicon
		FUSES:
F1	65-135105	10A
F2	65-61688	4A
F3	65-52293	5A
		COIL:
L1	25-84514G01	250 uH
		TRANSISTORS: (SEE NOTE)
Q1, 2	48-869698	NPN; type M9698
Q3	48-869701	PNP; type M9701
Q7, 11, 12	48-869627	NPN; type M9627
Q13	48-869700	NPN; type M9700
		RESISTORS: fixed; ±10%, unless otherwise stated
R1	6-125C49	1k; 1/2 W
R2	17-82177B20	50; 7 W
R8	6-124C47	820; 1/2 W
R9 thru 12	17-82177B50	.1; 7 W
R20	6-125C49	1k; 1/2 W
		TRANSFORMER, power
T1	25-82623L01	120 V AC; 60 Hz (TRN1151 only) primary: BLK-BLK (WHT = .377 ohms) secondary: RED-RED = .031 ohms, GRN-RED = .138 ohms
	or	
	25-82623L02	120 V AC; 50 Hz (TRN1152 only) primary: WHT-BLK = 1.7 ohms secondary: RED-RED = .033 ohms, GRN-GRN = .152 ohms
		MECHANICAL PARTS
	1-80793B96	COVER ASSEMBLY includes:
	1-80790B99	COVER, riveted includes:
	15-82683L01	COVER, power supply
	3-136138	SCREW, tapping; #6-32 x 3/8"; 4 used
	42-83123F01	RETAINER; 4 used
	1-80791B24	HEAT SINK ASSEMBLY includes:
	2-7005	NUT, hex; 6-32 x 1/4" x 3/32"; 4 used
	3-3398	SCREW, tapping; #6-20 x 3/8"
	3-488100	SCREW, machine; 6-32
	4-7569	WASHER, flat; .145-.312-.027"; 4 used
	4-7650	WASHER, lock; #6 internal; 2 used
	4-7666	WASHER, lock; #6 external
	4-474216	WASHER, insulated; 4 used
	4-84496C01	WASHER, shoulder; 4 used
	14-865854	INSULATOR, transistor; 2 used
	26-84923B01	HEAT SINK
	29-5207	LUG, solder; #6; 2 used
	29-84489B01	LUG, transistor; 4 used
	42-10217A01	STRAP, cable harness
	1-80791B23	CHASSIS, power supply, riveted includes:
	4-8242	WASHER, flat; .094-.250-.027"; 4 used
	9-84935D01	SOCKET, transistor; 3 used
	9-83662A01	SOCKET, transistor; 2 used
	31-121701	TERMINAL, strip; 5 pin
	27-82682L01	CHASSIS, power supply
	2-7005	NUT, hex; 6-32 x 1/4 x 3/32"; 4 used (TRN6731A only)
	3-135664	SCREW, tapping; #6-32 x 9/16"; 4 used (TRN6731A only)
	4-7669	WASHER, lock; #6 split; 4 used (TRN6731A only)
	29-812979	LUG, solderless; 4 used (TRN6731A only)
	29-847854	LUG, slotted tongue; (TRN6718A) 5 used (TRN6731A only)
	2-115123	NUT, hex; 10-32 x 3/8 x 1/8"; 4 used
	2-119913	NUT, hex; 8-32 x 11/32 x 1/8"; 2 used
	3-2957	SCREW, machine; 8-32 x 1/2"; 2 used
	3-3360	SCREW, tapping; #6-20 x 1/2"; 10 used
	3-7184	SCREW, machine; 6-32 x 1/2"; 4 used
	3-134214	SCREW, tapping; #6-32 x 5/8"
	3-7257	SCREW, machine; 8-32 x 5/8"; 4 used
	3-134214	SCREW, tapping; #6-32 x 5/8"
	3-136138	SCREW, tapping; #6-32 x 3/8"; 2 used
	3-136140	SCREW, tapping; #8-32 x 5/8"; 2 used
	3-138216	SCREW, tapping; #10-32 x 3/8"; 4 used
	7-82737L01	BRACKET
	9-82083C01	RECEPTACLE, fuse; 3 used
	29-5321	LUG, soldering; #10
	30-858552	CABLE, battery; #12 black; 11 used
	30-858553	CABLE, battery; #12 red; 11 used
	30-83211C01	AC CORD and PLUG
	9-83238C02	OUTLET, AC; 3 prong (TRN6718A only)
	31-50378	TERMINAL, board
	31-82272B05	TERMINAL, board; 4 pin (TRN6731A only)
	54-83532H01	LABEL, caution

NOTE:

For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TAB 1. DESCRIPTION

TAB 2. INSTALLATION

TAB 3. STATION MAINT
POWER SUPPLY

STATION MAINTENANCE
MAINTENANCE LOG SHEET
METERING & INTERCOM
POWER SUPPLY

TAB 4. TRANSMITTER

ALIGNMENT
MAINTENANCE
INTERCONNECT BOARD
EXCITER/1ST BANDPASS FILTER
POWER AMPLIFIERS
POWER CONTROL BOARD/
ANTENNA NETWORK/CONTROL STAGE
"PRIVATE–LINE" ENCODERS

TAB 5. RECEIVER

ALIGNMENT
MAINTENANCE
INTERCONNECT BOARD
RF & IF
AUDIO & SQUELCH
"PRIVATE–LINE" DECODERS

ALIGNMENT

1. EXCERPTS FROM FCC REGULATIONS

1.1 Radio transmitters may be tuned or adjusted only by persons holding a first or second class commercial radiotelephone operator's license or by personnel working directly under their immediate supervision.

1.2 The power input to the final radio frequency stage shall not exceed the maximum figure specified on the current station authorization. This power input shall be measured and the results recorded:

(1) When the transmitter is initially installed.

(2) When any change is made in the transmitter which may increase the power input.

(3) At intervals not to exceed one year.

1.3 Frequency and deviation of a transmitter must be checked:

(1) When it is initially installed.

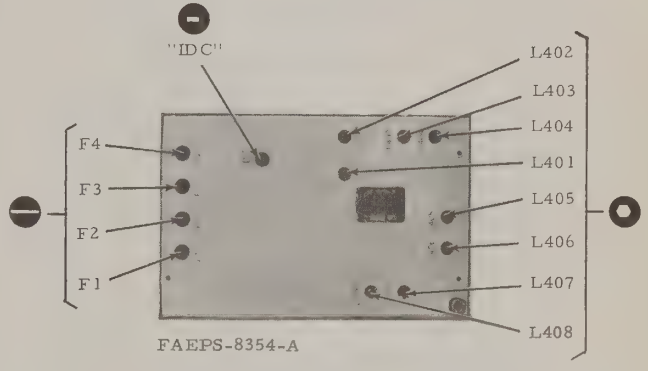
(2) When any change is made in the transmitter which may affect the carrier frequency or modulation characteristics.

(3) At intervals not to exceed one year.

2. GENERAL

The station adjustments are broken down into a series of major alignments, adjustments, or checks. For complete alignment and adjustment of the station, a sequence of adjustments should be used (Exciter, PA, etc.). For a particular touch-up or check, only the particular step-by-step procedure is required.

3. EXCITER ALIGNMENT PROCEDURE



Exciter Adjustment Locations

MOTOROLA INC.
Communications Division

service publications
1301 E. Algonquin Road, Schaumburg, IL 60196

METERING NOTE

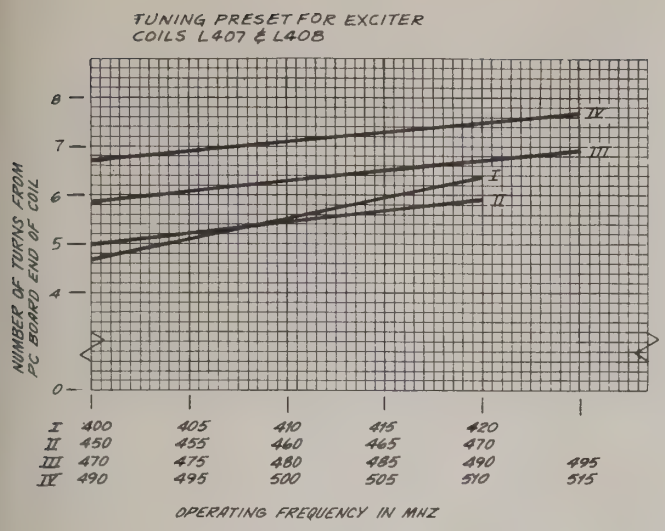
With upright model stations, metering is performed using built-in metering capability. With "Compa-Station" radios, metering may be performed using either optional built-in metering (if so equipped) or by using a Motorola S1056B thru S1059B Series Portable Test Set. All meter readings are based on a 2000 ohm equivalent series resistance in the meter. Therefore, meters not having a 2000 ohm series resistance must have their readings corrected. The following Exciter Alignment Procedure is written to cover all three cases. The OSC. & METER REV. SWITCH column refers to portable test set usage -- polarity is automatically reversed as required when built-in metering is used.

EXCITER ALIGNMENT PROCEDURE

(Refer to preceding Metering Note)

STEP	ADJUST	METERING PLUG INSERTED INTO	SELECTOR SWITCH POSITION	METER REV. SWITCH AND REF A-B SWITCH (SEE NOTE)	STAGE AND PROCEDURE
1					SET UP - Key the transmitter with the XMTR ON pushbutton on the portable test set.
2	POWER SET				OUTPUT - Turn the POWER SET control fully counterclockwise. Unkey the transmitter.
3	FRE-QUENCY SWITCH	EXCITER	2	OFF REF A	CHANNEL ELEMENT - Select the desired frequency on multi-frequency stations. Key the transmitter. Meter 2 should indicate at least 10 uA.
4	ALL EXCITER COILS	EXCITER	5	OFF REF A	PRE-ALIGNMENT - If the exciter is completely untuned and shows no meter 5 readings, set cores of tuning coils L401 thru L406 to the top of their coil forms (away from circuit board) and preset tuning coils L407 & L408 from circuit board end of coil form per Table 1.
5	L401	EXCITER	2	OFF REF A	BUFFER OUTPUT - Tune L401 for minimum meter reading.
6	L401, L402	EXCITER	3	OFF REF A	BUFFER OUTPUT - Tune L402 and then L401 for peak meter reading.
7	L403	EXCITER	3	OFF REF A	TRIPLER OUTPUT - Tune L403 for minimum meter reading.
8	L403, L404	EXCITER	4	OFF REF A	TRIPLER OUTPUT - Tune L404 and then L403 for peak meter reading.
9	L405	EXCITER	4	OFF REF A	FIRST DOUBLER OUTPUT - Tune L405 for minimum meter reading.
10	L405, L406	EXCITER	5	OFF REF A	FIRST DOUBLER OUTPUT - Tune L406 and then L405 for peak meter reading.
11	L407	EXCITER	5	OFF REF A	EXCITER OUTPUT - Tune L407 for peak meter reading.
12	L407, L408	EXCITER	5	OFF REF A	EXCITER OUTPUT - Tune L408 and then L407 for peak meter reading.
13					Repeat steps 6, 8 and 10.
14					"Power Set" the power amplifier.

Table 1.

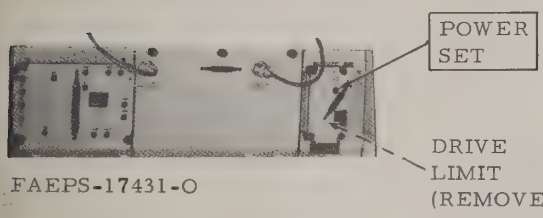


NOTE: ACTUAL SETTING IS NOT CRITICAL. NEAREST 1/4 TURN IS ADEQUATE.

4. POWER AMPLIFIER POWER SETTING PROCEDURE

NOTE

The transmitter power amplifier is broadband. Any channel may be used for initial PA power setting. See step-by-step procedure for final PA power setting.



Power Set and Drive Limit Control Locations

Table 2.

406-420 MHz

Model	Power Output	Drive Limit	Power Set
B/C34	12	15	12
B/C54	45	55	45
B/C64	75	88	75

450-470 MHz

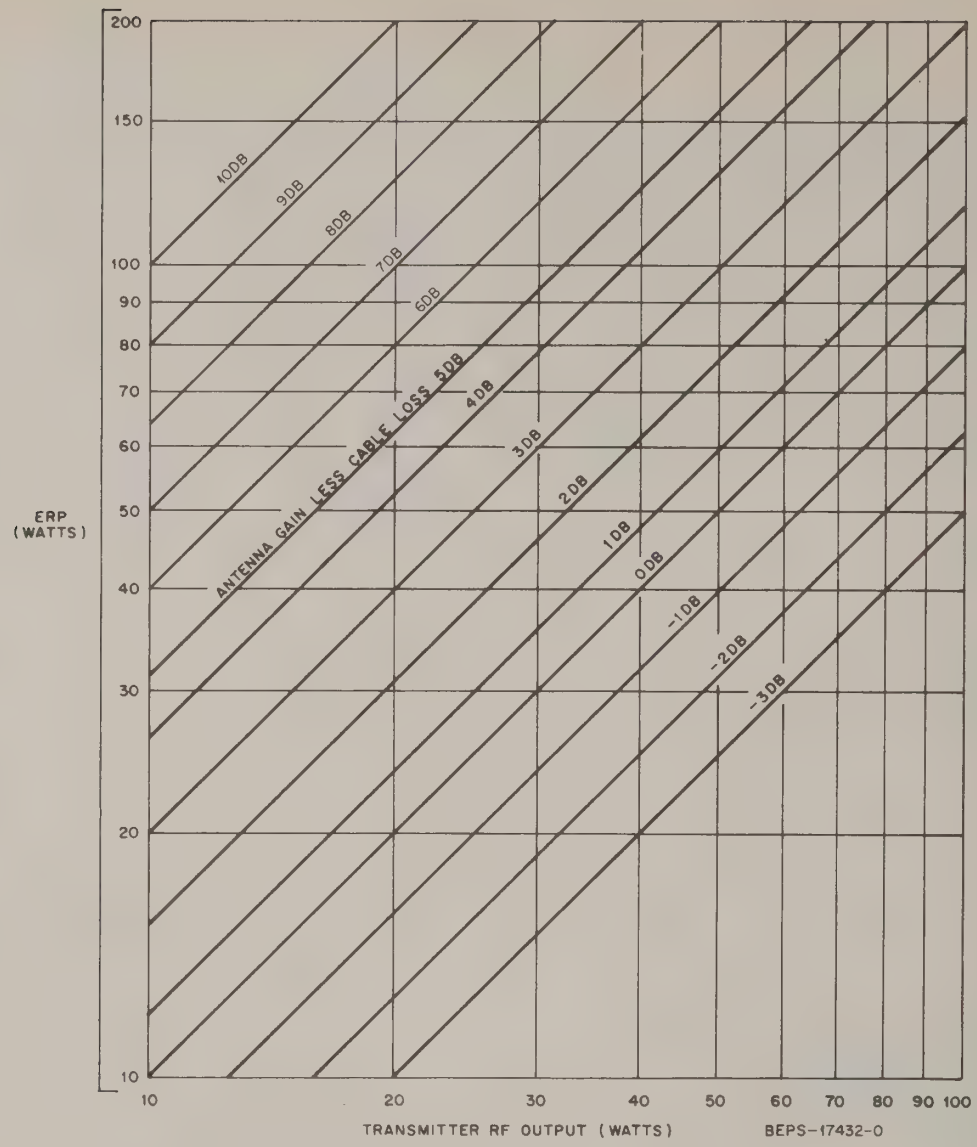
Model	Power Output	Drive Limit	Power Set	DC Input
B/C34	12	15	12	30
B/C44	20	25	20	60
B/C54	45	55	45	120
B/C64	75	88	75	180

470-512 MHz

Model	Power Output	Drive Limit	Power Set	ERP*
B/C34	12*	15	12	Adjust power output to power shown or per system to obtain EFFECTIVE RADIATED POWER per station license.
B/C44	20*	25	20	
B/C54	40*	50	40	
B/C64	60*	70	60	

NOTE

Power output of 470-512 MHz stations is subject to FCC EFFECTIVE RADIATED POWER (ERP) licensing rules. Refer to the manufacturer's specification sheet for loss/gain factors involved in transmission lines, antennas, duplexers, etc. For example, the power loss in Teflon coaxial cable (Motorola part no. 30-84173E01-RG400) is nominally 0.1 dB/foot.



Graph of Effective Radiated Power

PA POWER SETTING PROCEDURE

NOTE

If transmitter is to be brought back up to rated power after turning down the Power Set control for alignment or troubleshooting procedures, proceed directly to Step 4.

Step	Adjust	Metering Plug Location	Test Set Selector Switch Position	Meter Rev. Switch & Ref. A-B Switch	Stage and Procedure
1	Power Set and Drive Limit	Power Control Board	Watt-meter		Pre-Setting of Controls: Adjust the Drive Limit control fully counterclockwise (maximum drive limit). Adjust the Power Set control 1/3 turn from fully counterclockwise (just up from minimum power output). Connect a wattmeter to the station rf output connector and remove the shield from over the power control board.
2	Power Set	Power Control Board	Watt-meter		Power Set: Key Transmitter. Adjust the Power Set control clockwise until the power output under Drive Limit in Table 2 is obtained. If power output limits before that value is obtained, adjust power set control to maximum clockwise.

PA POWER SETTING PROCEDURE (Cont'd.)

Step	Adjust	Metering Plug Location	Test Set Selector Switch Position	Meter Rev. Switch & Ref. A-B Switch	Stage and Procedure
3	--	--	--		CAUTION: For proper operation of the power leveling circuitry, the drive limit control must not be set for any lower power output than that given in the "Drive Limit" column of Table 2. In radios where the drive limit power output level is not obtainable, the drive limit protection circuitry is not necessary and the drive limit control can be set to minimum.
3A	Drive Limit	Power Control Board	Watt-meter		Drive Limit: Key transmitter. If the proper level was attainable in Step 2, adjust the Drive Limit control counterclockwise to the value indicated in Table 2 under Drive Limit. Power output should just start to decrease. Do not exceed 1 watt drop. On multi-frequency radios, check power output on all channels. If necessary readjust Drive Limit control so the lowest power channel is set per Table 1 under Drive Limit. If the Drive Limit control cannot obtain a high enough reading, set it fully counterclockwise (minimum drive limit). Unkey transmitter. Replace power control board shield.
4	Power Set	Power Control Board	Watt-meter		Power Set: Key transmitter. Adjust the Power Set control CCW and set power output per Table 2 under Power Set. On multi-frequency radios, check power output on all channels. If necessary, readjust Power Set control so the lowest power channel is set per Table 2 under Power Set. Unkey transmitter. This completes the power setting procedure for 406-420 MHz. 470-512 MHz radios must be adjusted for system ERP. Refer to graph of Effective Radiated Power and Table 2. For radios in the 450-470 MHz band, proceed to Step 5.
5	Final Stage DC Power Input				DC power input to final stage can be determined by performing Steps 6, 7 and 8.
6	DC Current to Final PA Stage	Power Control Board for C34 Model	5	Meter Rev.	Final PA Stage Collector, I_C: The collector current in amperes is the meter reading (0-50 uA) times 1×10^5 on C34 series models, 2.5×10^5 on C44 & C54 series models and 5×10^5 on C64 series models. For example, 50 uA on meter corresponds to 5.0 amps on C34 series models, 12.5 amps on C44 & C54 series models and 25 amps on C64 series models. Indoor upright models have a 0-25 amp meter scale. On B34 series divide reading by 5. B44 and B54 readings are divided 2. The B64 reads direct.
		Power Ampl for C44, 54, 64 Models	3		
7	DC Voltage to Final PA Stage				Final PA Collector Voltage, Vc: The PA collector voltage is measured between the MTR (-) terminal and BLK power lead providing power to the PA on 20/45/75-watt models and between the RED and BLK leads on the back side of the unified chassis interconnect board on 12-watt models.
8	Final Stage DC Power Input				Final Stage DC Power Input: Calculate the final input power, Pin = Vc x Ic. A list of the dc inputs for the various radio set models is given in Table 2.

5. OSCILLATOR FREQUENCY ADJUSTMENT

Step 1. Key the transmitter with no modulation (key the transmitter with the XMTR ON push-button on the portable test set rather than with the microphone). On tone-coded "Private-Line" stations, unplug the "Vibrasender" resonant reed from the PL tone generator. On digital-coded "Private-Line" stations, short the PL disable pin (J701) to ground (J702). A Motorola Model TRN6332A Code Disable Plug is available for this purpose.

Step 2. Adjust the channel element warp capacitor for the selected channel to the exact desired frequency. On single-frequency models, adjust the F1 channel element warp capacitor. On multi-frequency models, adjust the warp capacitor which corresponds to the frequency selector switch setting; repeat for each frequency.

6. "IDC" ADJUSTMENT PROCEDURES

Step 1. Each channel element must be "warped" on frequency before setting "IDC". Connect the audio oscillator to the exciter input.

Step 2. Set the audio oscillator to 1000 Hz and 1 volt. On "Private-Line" models, re-enable PL.

Step 3. Key the transmitter and adjust the "IDC" control for ±5 kHz deviation.

Step 4. Reduce the tone oscillator output to .25 volt. Essentially full deviation should still be indicated. Less than full deviation may indicate a weak audio stage.

MAINTENANCE

1. INTRODUCTION

This section of the manual provides the maintenance shop type procedures for the individual transmitter circuits in the station. It assumes that preliminary tests have already localized the trouble to the particular area. These bench tests include measurements with a built-in station meter or Motorola portable test set, and procedures for testing and troubleshooting; including integrated circuit check-out.

NOTE

Photographs used in this section to aid in strip-line repair represent typical views only. That is, some photographs show strip-line assemblies in mobile radios. Strip-line repair, in itself, is applicable to these base and repeater stations.

2. EXCITER MAINTENANCE

NOTE

The exciter board must be installed in the transmitter for testing to provide the necessary power, ground, control and signal connections. The circuit board should always be secured in place with all mounting screws for operation and testing to provide good rf ground to all stages of the exciter. The exciter should be tested while installed in the station -- usually the preferred method. However, if desired, it can be bench tested in a VHF (132-174 MHz) "Micor" mobile radio, except that the time-out timer is inoperative.

2.1 METERING

2.1.1 The exciter is equipped with a metering receptacle which allows five major test points to be measured. The output of the exciter is measured on meter position 5. With the portable test set connected to the metering receptacles, or by using the built-in station metering kit (if so equipped), readings may be made at each of the major test points in the circuit. A failure in almost any portion of the exciter will produce a low or zero meter reading for one or more of the test points. Improper alignment will also cause improper meter readings.

2.1.1.1 Using Built-In Station Metering

Step 1. The output of the exciter must be terminated into its normal point, the first bandpass filter. The output of the station, thru the antenna

network, must be terminated in a 50-ohm dummy load or an antenna.

Step 2. Plug the metering plug into the exciter metering receptacle.

Step 3. Turn the station ON.

Step 4. Set the selector switch on the built-in station metering kit to position 1. Key the transmitter and whistle into the microphone long enough to observe the meter reading.

Step 5. Set the selector switch to positions 2, 3, 4 and 5 respectively, keying the transmitter and observing the meter readings for each position (whistling not required). On multi-frequency stations, repeat the readings for each exciter frequency. An analysis of the meter readings for determining whether each circuit is good or bad follows in the "Performance Tests" paragraph.

2.1.1.2 Using the Portable Test Set

To make the measurements using a portable test set, the portable test set must be connected to the station as listed in the following procedure.

Step 1. Connect the 20-pin plug of the test set adapter cable to the test set. When the test set is not in use, disconnect the 20-pin plug to conserve battery life. The plug acts as an on-off switch completing the battery circuit.

Step 2. Connect the red "control" plug of the adapter cable to the control receptacle on the unified chassis interconnect board. Connect the white "metering" plug of the adapter cable to the metering receptacle on the exciter circuit board.

Step 3. Set the function selector switch of the portable test set to the XMTR position.

Step 4. Set the oscillator and meter reversing switch of the test set to the OFF position.

Step 5. Set the 1 V-100 mV switch on the adapter cable to the 100 mV position (TEK-37). On the later version adapter cable (TEK-37A), the switch is omitted and the unit operates at 100 mV sensitivity.

Step 6. Set the REF A-B switch on the adapter cable to position A.

Step 7. The output of the exciter must be terminated into its normal point, the first bandpass filter. The output of the station, thru the antenna network, must be terminated in a 50-ohm dummy load or an antenna.

Step 8. Turn the station ON.

Step 9. Connect a microphone to the microphone receptacle on the portable test set or to the unified chassis interconnect board.

Step 10. Set the selector switch of the test set to position 1. Using the push-to-talk switch on the microphone, key the transmitter and whistle into the microphone long enough to observe the meter reading.

Step 11. Set the selector switch to positions 2, 3, 4 and 5 respectively, keying the transmitter with the XMTR ON pushbutton on the test set or the push-to-talk switch on the microphone and observing the meter reading for each position. On multi-frequency stations, repeat the readings for each exciter frequency. An analysis of the meter readings for determining whether each circuit is good or bad follows in the "Performance Tests" paragraph.

2.1.2 Each time maintenance is performed on the exciter, the readings should be compared with the previous set of readings. Any degradation of performance will quickly be noted. Often, a lower reading may indicate an impending failure and corrective action may be taken before the circuit fails entirely. The minimum values given in the table may be used if no previous readings are available. However, these readings are an absolute minimum for normal operation and are no substitute for a log of meter readings. A typical exciter may have much higher readings and should not be allowed to drop to these minimum values before corrective action is taken. If a log is maintained, even small drops in meter readings will be noticed. This condition should be interpreted as abnormal operation and corrective action taken (such as realignment) to assure continued peak performance.

2.2 PERFORMANCE TESTS

The performance tests may be used for troubleshooting to isolate the point of abnormal performance. They may also be used after repair and alignment to assure that the exciter meets all specifications before it is returned to service.

TYPICAL EXCITER METER READINGS

SELECTOR SWITCH POSITION	REFERENCE SWITCH POSITION (TEST SET ONLY)	READING	CIRCUIT METERED	IF LOW, THE DEFECTIVE CIRCUIT IS
1	A	2 (no mod) 10 (120 mV audio at Mic input)	Audio output of IDC circuit	IDC circuit
2	A	25	Channel element output	Channel element
3	A	38	Tripler input	Modulator or Tripler
4	A	15	1st doubler input	Tripler or 1st doubler
5	A	20	Exciter output	1st doubler, 2nd doubler or amplifier

2.2.1 Power Output Test

2.2.1.1 Specifications

Step 1. The exciter shall provide at least 400 milliwatts rf output on 1/3 of the assigned frequency.

Step 2. On multi-frequency stations with frequency separation of less than ±850 kHz, at least 400 milliwatts output shall be provided on each channel.

2.2.1.2 Procedure

Step 1. Connect the equipment as connected for Metering, except connect the test set "metering" plug to the exciter metering receptacle.

Step 2. Set the selector switch to position 5. This checks the input to the output of the exciter. A meter reading of at least 20 uA equals an rf signal level of 400 milliwatts.

Step 3. On multi-frequency stations, repeat the test for each exciter frequency. Select the frequency to be tested by the frequency selector switch associated with the station. The test set meter 2 should indicate at least 20 uA for each frequency.

2.2.2 Frequency Test

2.2.2.1 Specifications

The carrier frequency output of the exciter shall be within .0002% of the assigned frequency for each channel of operation.

2.2.2.2 Procedure

Step 1. Terminate the transmitter in an antenna and measure the radiated signal with a Motorola digital frequency meter and deviation monitor or other highly accurate frequency measuring device (±.00005% or better) when the transmitter is keyed in the following steps.

Step 2. Key the transmitter to produce an unmodulated carrier signal. In tone-coded "Private-Line" stations disable the "Private-Line" encoder by unplugging the "Vibrasender" resonant reed. In digital-coded "Private-Line" stations, disable the "Private-Line" encoder by shorting the PL disable pin (J701) to ground (J702).

NOTE

Do not use the push-to-talk switch on the microphone. Background noise will modulate the signal.

Step 3. Read the transmitter output frequency. On multi-frequency stations, repeat the test for each frequency.

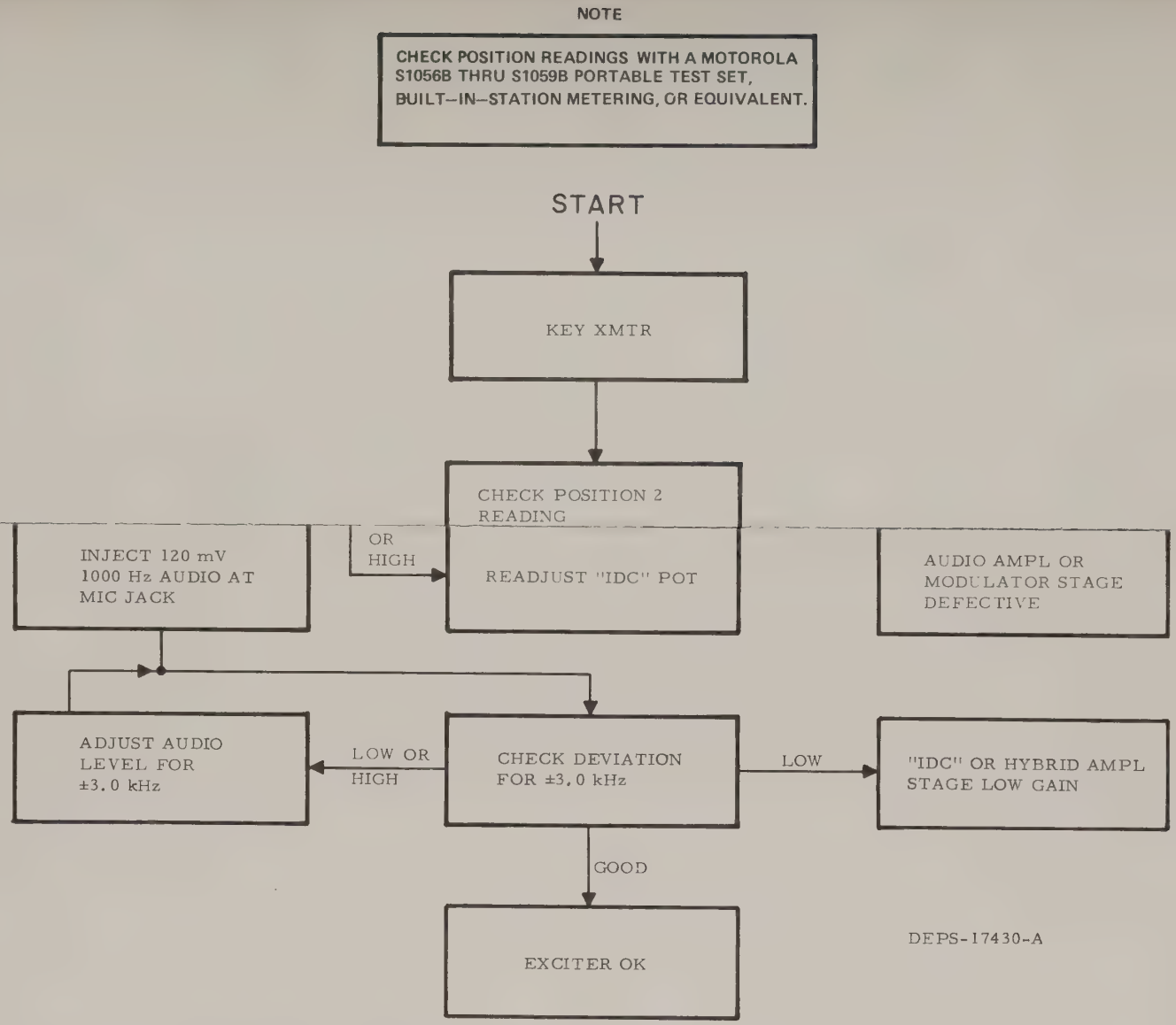
Step 4. If adjustment is required, set the "warp" capacitor on the associated channel element for the assigned frequency output. For best accuracy, the radio set should be brought to room temperature (+70° to 75°F) and the test equipment thoroughly warmed up. This brings the channel element to the center of its temperature compensation range. Once calibrated at this temperature, it can most accurately compensate for future temperature changes.

2.2.3 Deviation Test

2.2.3.1 Specifications

Step 1. The exciter output shall deviate ±5 kHz with audio input of 1 volt @ 1000 Hz.

Step 2. In "Private-Line" stations, the exciter output shall deviate 0.5 to 1 kHz with "Private-Line" modulation applied.


NOTE
CHECK POSITION READINGS WITH A MOTOROLA S1056B THRU S1059B PORTABLE TEST SET, BUILT-IN-STATION METERING, OR EQUIVALENT.
START
KEY XMTR
CHECK POSITION 2 READING
INJECT 120 mV 1000 Hz AUDIO AT MIC JACK
OR HIGH
READJUST "IDC" POT
AUDIO AMPL OR MODULATOR STAGE DEFECTIVE
ADJUST AUDIO LEVEL FOR ±3.0 kHz
LOW OR HIGH
CHECK DEVIATION FOR ±3.0 kHz
LOW
"IDC" OR HYBRID AMPL STAGE LOW GAIN
GOOD
EXCITER OK
DEPS-17430-A

EXCITER TROUBLESHOOTING CHART

TYPICAL EXCITER METER READINGS

SELECTOR SWITCH POSITION	REFERENCE SWITCH POSITION (TEST SET ONLY)	READING	CIRCUIT METERED	IF LOW, THE DEFECTIVE CIRCUIT IS
1	A	2 (no mod) 10 (120 mV audio at Mic input)	Audio output of IDC circuit	IDC circuit
2	A	25	Channel element output	Channel element
3	A	38	Tripler input	Modulator or Tripler
4	A	15	1st doubler input	Tripler or 1st doubler
5	A	20	Exciter output	1st doubler, 2nd doubler or amplifier

2.2.1 Power Output Test

2.2.1.1 Specifications

Step 1. The exciter shall provide at least 400 milliwatts rf output on 1/3 of the assigned frequency.

Step 2. On multi-frequency stations with frequency separation of less than ±850 kHz, at least 400 milliwatts output shall be provided on each channel.

2.2.1.2 Procedure

Step 1. Connect the equipment as connected for Metering, except connect the test set "metering" plug to the exciter metering receptacle.

Step 2. Set the selector switch to position 5. This checks the input to the output of the exciter. A meter reading of at least 20 uA equals an rf signal level of 400 milliwatts.

Step 3. On multi-frequency stations, repeat the test for each exciter frequency. Select the frequency to be tested by the frequency selector switch associated with the station. The test set meter 2 should indicate at least 20 uA for each frequency.

2.2.2 Frequency Test

2.2.2.1 Specifications

The carrier frequency output of the exciter shall be within .0002% of the assigned frequency for each channel of operation.

2.2.2.2 Procedure

Step 1. Terminate the transmitter in an antenna and measure the radiated signal with a Motorola digital frequency meter and deviation monitor or other highly accurate frequency measuring device (±.00005% or better) when the transmitter is keyed in the following steps.

Step 2. Key the transmitter to produce an unmodulated carrier signal. In tone-coded "Private-Line" stations disable the "Private-Line" encoder by unplugging the "Vibrasender" resonant reed. In digital-coded "Private-Line" stations, disable the "Private-Line" encoder by shorting the PL disable pin (J701) to ground (J702).

NOTE

Do not use the push-to-talk switch on the microphone. Background noise will modulate the signal.

Step 3. Read the transmitter output frequency. On multi-frequency stations, repeat the test for each frequency.

Step 4. If adjustment is required, set the "warp" capacitor on the associated channel element for the assigned frequency output. For best accuracy, the radio set should be brought to room temperature (+70° to 75°F) and the test equipment thoroughly warmed up. This brings the channel element to the center of its temperature compensation range. Once calibrated at this temperature, it can most accurately compensate for future temperature changes.

2.2.3 Deviation Test

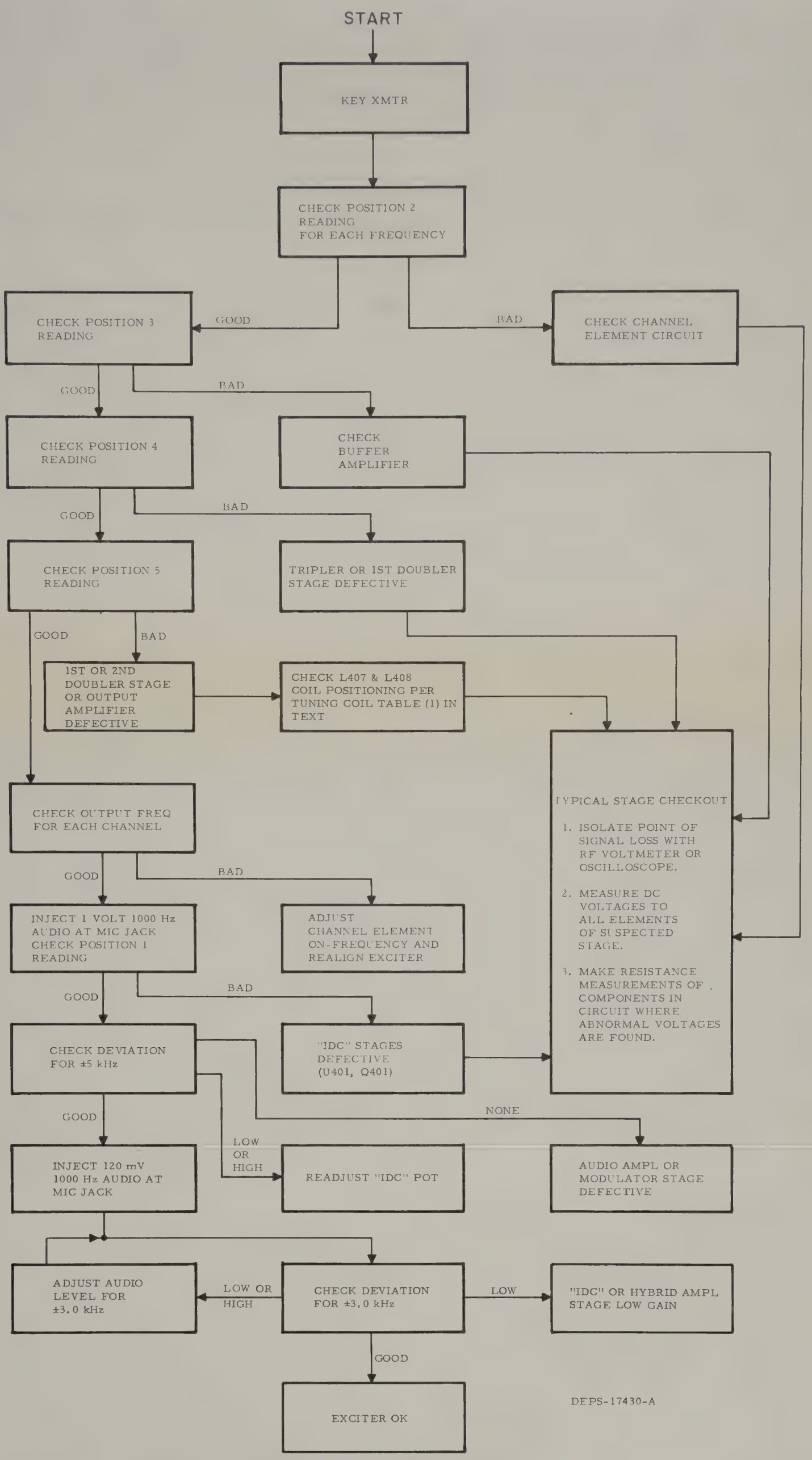
2.2.3.1 Specifications

Step 1. The exciter output shall deviate ±5 kHz with audio input of 1 volt @ 1000 Hz.

Step 2. In "Private-Line" stations, the exciter output shall deviate 0.5 to 1 kHz with "Private-Line" modulation applied.

NOTE

CHECK POSITION READINGS WITH A MOTOROLA S1056B THRU S1059B PORTABLE TEST SET, BUILT-IN-STATION METERING, OR EQUIVALENT.


START
KEY XMTR
CHECK POSITION 2 READING FOR EACH FREQUENCY
GOOD
BAD
CHECK POSITION 3 READING
CHECK CHANNEL ELEMENT CIRCUIT
GOOD
BAD
CHECK POSITION 4 READING
CHECK BUFFER AMPLIFIER
GOOD
BAD
CHECK POSITION 5 READING
TRIPLER OR 1ST DOUBLER STAGE DEFECTIVE
GOOD
BAD
1ST OR 2ND DOUBLER STAGE OR OUTPUT AMPLIFIER DEFECTIVE
CHECK L407 & L408 COIL POSITIONING PER TUNING COIL TABLE (1) IN TEXT
CHECK OUTPUT FREQ FOR EACH CHANNEL
GOOD
BAD
INJECT 1 VOLT 1000 Hz AUDIO AT MIC JACK CHECK POSITION 1 READING
ADJUST CHANNEL ELEMENT ON-FREQUENCY AND REALIGN EXCITER
GOOD
BAD
CHECK DEVIATION FOR ±5 kHz
"IDC" STAGES DEFECTIVE (U401, Q401)
GOOD
LOW OR HIGH
NONE
INJECT 120 mV 1000 Hz AUDIO AT MIC JACK
READJUST "IDC" POT
AUDIO AMPL OR MODULATOR STAGE DEFECTIVE
ADJUST AUDIO LEVEL FOR ±3.0 kHz
LOW OR HIGH
CHECK DEVIATION FOR ±3.0 kHz
LOW
"IDC" OR HYBRID AMPL STAGE LOW GAIN
GOOD
EXCITER OK
TYPICAL STAGE CHECKOUT
1. ISOLATE POINT OF SIGNAL LOSS WITH RF VOLTMETER OR OSCILLOSCOPE.
2. MEASURE DC VOLTAGES TO ALL ELEMENTS OF SUSPECTED STAGE.
3. MAKE RESISTANCE MEASUREMENTS OF COMPONENTS IN CIRCUIT WHERE ABNORMAL VOLTAGES ARE FOUND.
DEPS-17430-A

EXCITER TROUBLESHOOTING CHART

2.2.3.2 Procedure

Step 1. Terminate the station output in an antenna and measure the radiated signal with a deviation meter.

Step 2. In "Private-Line" stations, re-enable PL that was disabled in the previous test. Key the transmitter with only "Private-Line" tone modulation. The deviation meter should indicate 0.5 to 1 kHz.

Step 3. Connect an audio oscillator output to pins 12 and 19 on the Exciter Board. Adjust the audio oscillator to 1000 Hz and 1 volt as measured on an ac voltmeter. The deviation meter should indicate ±5 kHz deviation.

Step 4. Adjust the audio oscillator over the entire 300 to 3000 Hz range, keeping the audio level at approximately 1 volt. The deviation meter should never exceed ±5 kHz nor drop below ±2.5 kHz.

2.2.4 Audio Sensitivity Test

2.2.4.1 Specification

An audio input of 120 millivolts at 1000 Hz shall produce approximately ±3.0 kHz deviation.

2.2.4.2 Procedure

Step 1. After completion of the Deviation Test, reduce the output of the audio oscillator to 120 millivolts at 1000 Hz.

Step 2. The deviation meter should indicate approximately ±3.0 kHz. Meter position 1 may be noted at this time for future reference. Future audio sensitivity checks may then be made by comparing the meter 1 reading with the reference value.

2.3 TROUBLESHOOTING

2.3.1 Check Input Voltages

2.3.1.1 If there are no test set indications at one or more of the metered points, check the dc input voltages to the exciter circuit board.

P902-11 & 13	+9.6 volts in respect to chassis
P902-6	Keyed A- (approximately -13.6 volts in respect to A+, pin 7) when keyed.

2.3.1.2 If test set indications localize the trouble to a specific stage or two, measure the dc input voltages to the suspected stages. Refer to the schematic diagram for the normal voltages.

NOTE

In "Private-Line" stations, the transmitter cannot be keyed if the PL encoder is removed unless a jumper (JU401) is connected from pin 8 to pin 10 of the exciter to complete the keying circuit. This jumper is permanently connected in exciters for non-"Private-Line" operation.

2.3.2 Alignment as a Troubleshooting Technique

Low test set readings, low power output, and subnormal performance are very often corrected by realignment. Therefore, alignment should be the first troubleshooting step performed for these symptoms. Many technicians prefer to use alignment as the first troubleshooting step in all cases. During the alignment procedure, any trouble caused by a defective component will be discovered and corrected before alignment can be completed.

2.3.3 Isolating Defective Components

If test set readings are abnormal or tests indicated subnormal performance, a logical trouble shooting procedure is required to isolate the defective component efficiently. The meter readings and results of performance tests usually localize the malfunction to one or two specific stages. A zero meter reading indicates either (1) no drive from the preceding stages, or (2) a defective component in the metering circuit which includes the base-emitter junction of the following transistor which operates as a rectifier. The accompanying troubleshooting chart summarizes these results in a logical sequence. A few voltage and resistance checks in the suspected circuit should readily isolate the defective component. Note that the final amplifier stage of the exciter is powered by A+ and keyed A- and voltages should be checked in respect to keyed A- instead of chassis ground.

3. TRIPLER/LOW LEVEL AMPLIFIER MAINTENANCE

NOTE

Field servicing of the tripler/low level amplifier should not be attempted. If the tripler/low level amplifier is defective, replace the entire unit. Removal and replacement is described following performance testing.

3.1 PERFORMANCE TESTS

Step 1. Be sure the transmitter is not keyed. Turn the Drive Limit control fully counterclockwise (minimum drive limit).

Step 2. Check all PA transistors except for those in the controlled stage for proper collector operating voltages (+13.6 volts). The controlled stage collector voltage cannot be checked until later in this procedure.

Step 3. Turn the POWER SET control fully counterclockwise (minimum power output).

Step 4. Connect a UHF-rated wattmeter to the transmitter output connector with an 8-inch or shorter length of coaxial cable. The wattmeter must be terminated in a 50-ohm resistive dummy load.

Step 5. Disconnect the transmitter output coax cable connector from the antenna network.

Step 6. Disconnect the rf connector from the output jack on the tripler/low-level amplifier. Connect the tripler/low-level amplifier output to the antenna network input using a short BNC to BNC adapter cable.

Step 7. Key the transmitter and check the tripler/low-level amplifier output. The wattmeter reading should be at least 0.8 watt. If a minimum of 0.8 watt cannot be obtained, connect a short phono to BNC adapter cable between the tripler filter output port and the antenna network input connector. The wattmeter should read at least 0.08 watt.

Step 8. If the tripler/low-level amplifier power output is low, check exciter meter position 5. With the REF switch on the TEK-37A test set adapter cable set to B, the meter 5 reading should be at least 15 uA. If the meter 5 reading is low, the exciter is defective. If the meter 5 reading is 15 uA or greater, the tripler/low-level amplifier is bad. Also check all rf cable connectors and the bandpass filters.

3.2 TRIPLER/LOW LEVEL AMPLIFIER REMOVAL AND REINSTALLATION PROCEDURE

NOTE

All steps are performed from the front of the station.

3.2.1 All Models Except 12-Watt Models

Step 1. Disconnect the coaxial cables interconnecting the power amplifier to the LOW LEVEL AMP OUT and ANT NETWORK IN connectors from the unichassis.

Step 2. Loosen the three captivated shield cover screws and remove the shield cover.

Step 3. Loosen the captivated screw that holds the LOW LEVEL OUTPUT receptacle bracket and remove the receptacle from its mounting bracket.

Step 4. To reinstall the tripler/low-level amplifier, reverse the procedure given in steps 1-3.

3.2.2 12-Watt Models Only

Step 1. Loosen the two captivated power amplifier assembly screws on the PA heat sink.

Step 2. Pivot and lift the PA assembly up and off the pivot bushing and simultaneously disconnect the following connectors:

-- power plug from 12 W PA receptacle on transmitter interconnect board.

-- tripler plug from low level amplifier output receptacle on tripler/low-level amplifier.

-- PA output plug from antenna network.

The PA assembly is now completely disconnected from the unified chassis and can be placed to one side.

Step 3. Loosen the three captive screws used to mount the 12-watt PA mounting bracket and remove the bracket.

Step 4. Disconnect the plug connected to TRPLR receptacle on the transmitter interconnect board.

Step 5. Loosen the four captivated screws that hold the tripler/low-level amplifier in place.

Step 6. Carefully pull out the tripler/low-level amplifier part way and then disconnect the plug connected to the output of the first bandpass filter. The tripler/low-level amplifier is now completely disconnected.

Step 7. To reinstall the tripler/low-level amplifier, reverse the procedure given in steps 1 to 6.

4. POWER AMPLIFIER MAINTENANCE

CAUTION

The power amplifier stages must be installed in the station for testing to provide the necessary power, ground, control, heat sinking and signal connections.

4.1 PERFORMANCE TESTS

The only performance test needed for the power amplifier section of the transmitter is measurement of the rf power output at the transmitter output connector. Before performing the following test, be sure the exciter and tripler/low-level amplifier are operating properly.

Step 1. Connect an rf wattmeter to the transmitter output connector, using an 8-inch or shorter length of coaxial cable. Be sure the wattmeter and rf dummy load are rated for UHF use and that they are terminated in a resistive 50-ohm dummy load.

Step 2. Key the transmitter and observe the power output reading on the wattmeter.

Step 3. If necessary, adjust the POWER SET control on the power control board until rated transmitter power output is obtained. If rated power output cannot be obtained, remove the shield from the power control board and set the Drive Limit control fully counterclockwise. Replace the power control board shield, key the transmitter, and again adjust the POWER SET control for rated transmitter power output.

Step 4. If it was necessary to change the Drive Limit control setting to obtain rated transmitter output power, refer to the TRANSMITTER ALIGNMENT section of this instruction manual for the Drive Limit control adjustment procedure.

Step 5. If the performance test indicates that the power amplifier section of the radio set is not functioning properly, go to the following troubleshooting section.

4.2 TROUBLESHOOTING

If a transmitter malfunction has been isolated to the power amplifier circuits, the cause of the malfunction can be found by using the following procedures. Visual checks and operating voltage checks should be made before more extensive troubleshooting is begun.

4.2.1 Visual Checks

Step 1. Visually check for obvious physical defects, such as broken leads, broken or cracked microstrip substrates and broken or disconnected components. These defects should be corrected immediately. Then recheck the power amplifier performance. If the power amplifier fails the performance test, make voltage checks next.

Step 2. If the visual inspection reveals overheated components, do not replace the overheated parts until the cause of the overheating has been found and corrected. Otherwise, the new part may be damaged.

4.2.2 Voltage Checks

Check for A+ and A- at the feedthrough connections and for proper voltages at the collectors of each transistor. Certain defects such as cracked microstrips, intermittent leads, etc., may not be obvious to a visual inspection.

NOTE

Cracked microstrips can often be found by sliding the tip of a modeling knife blade or some other sharp object along the surface of the ceramic substrate. Usually, a noticeable "bump" will be felt as the sharp object passes over the crack in the microstrip.

4.2.3 Isolating Defective Components

If the visual and voltage checks do not reveal the cause of subnormal power amplifier performance, refer to the power amplifier troubleshooting chart, the interstage testing procedure, and the driver and final amplifier testing procedure. These sections provide systematic troubleshooting methods to help you isolate the defective power amplifier stage and component.

4.3 INTERSTAGE TESTING PROCEDURE

4.3.1 During the troubleshooting procedure it is sometimes desirable to determine the power output of an individual transmitter stage with a given input level. The following procedure can be used to supplement a procedure using the meter readings given on the power amplifier troubleshooting chart.

4.3.2 If this procedure shows that a PA stage is malfunctioning and must be repaired, refer to the Power Amplifier Repair Procedures part of this section of the instruction manual.

CAUTION

Due to the voltage requirements of NPN Transistors, all "rf ground" plating is at A-. Therefore, caution should be used to prevent connection of "ground" plating on the power amplifier to chassis ground, either directly or by the use of test equipment ground leads. If ac-operated test equipment is used, the ground lead must not be electrically connected to ac-line ground.

CAUTION

DO NOT "SHORT-CUT" THE FOLLOWING PROCEDURE. This procedure is designed to avoid situations in which excessive drive might be applied to the predriver or driver stages. Excessive drive could destroy the predriver or driver stages. It is possible to safely begin stage gain measurements at a lower power level stage than the predriver if metering indicates that one of these lower power level stages is not operating properly. UNDER NO CIRCUMSTANCES, however, should attempts be made to "short-cut" the following procedure by checking the driver or final PA stage without first checking the output of the predriver stage.

Step 1. Be sure the transmitter is not keyed. Turn the Drive Limit control fully counterclockwise (minimum drive limit).

Step 2. Check all PA transistors except for those in the controlled stage for proper collector operating voltages (+13.6 volts). The controlled stage collector voltage cannot be checked until later in this procedure.

Step 3. Turn the POWER SET control fully counterclockwise (minimum power output).

Step 4. Connect a UHF-rated wattmeter to the transmitter output connector with an 8-inch or shorter length of coaxial cable. The wattmeter must be terminated in a 50-ohm resistive dummy load.

Step 5. 12-W models -- proceed to step 7(a). 20-, 40-, and 45 W models -- disconnect the predriver output from the final amplifier and proceed to step 6. 60- and 75 W models -- disconnect the predriver output from the driver input stage and proceed to step 6.

Step 6. Using an adapter cable, connect the predriver output to the antenna network. The shield of the adapter cable should be soldered to the microstrip ground plating as close as possible to the point where the cable center conductor is soldered. Use a 50-watt soldering iron and silver solder (1.4% silver, 36.1% lead, 62.5% tin) as recommended in the Power Amplifier Repair Procedures part of this section of the manual. NEVER operate a PA stage without a proper 50-ohm termination.

NOTE

If the proper adapter cable is not available, the output of the predriver stage can be connected to an rf wattmeter with a short (less than 8") coaxial cable. Be sure the wattmeter is rated for use at UHF and is terminated in a 50-ohm resistive dummy load that is rated for UHF. Home-made dummy loads or radiating antennas are not adequate for these tests.

If the predriver output is connected directly to an rf wattmeter, the accuracy of the measurement will be affected. Remember that because the antenna network is not connected between the stage output and the wattmeter, the wattmeter readings will be about 15% greater than those listed in the PA stage power output table in this procedure.

Step 7. Defeat the "No Power" Protect circuit on the power control board as follows:

CAUTION

It is assumed that at this point in the procedure the interstage coupling to the transmitter final amplifier section has been disconnected to measure the power output of one of the earlier PA stages. In that case the following procedure is safe. IN NO CASE SHOULD THIS PROCEDURE BE USED WHEN DRIVE IS APPLIED TO THE TRANSMITTER FINAL AMPLIFIER STAGES.

7(a). Disconnect ac power from the station.

7(b). Remove the shield from over the power control board.

7(c). Refer to the power control board schematic diagram and circuit board detail. Locate capacitor C611.

7(d). Short the leads of C611 together, using a short piece of jumper wire soldered to the plating side of the circuit board. Be careful to avoid shorting any other plating.

7(e). Reconnect power to the station and proceed with the troubleshooting procedure.

Step 8. Key the transmitter. Slowly increase the predriver power output by turning the POWER SET control clockwise while watching the rf wattmeter. Set the predriver power output to the level specified in the PA stage power output table in this procedure. If the proper predriver power output setting can be obtained, go directly to step 3 of the Driver and Final Amplifier Testing Procedure.

Step 9. If the proper predriver power output settings cannot be obtained; perform the following:

12 W models -- Using an adapter cable, connect the controlled stage output to the antenna network (soldering techniques and requirements are described in step 6).

All models except 12 W models -- Disconnect the test cable from the predriver output and connect it to the controlled stage output.

Step 10. Key the transmitter and check the controlled stage output power reading on the rf wattmeter. If the controlled stage output power is at least the value given in the PA stage power output table, the predriver stage is defective.

Step 11. If the controlled stage power output is low, check the controlled stage transistor collector voltage with the POWER SET control set fully clockwise. If the drive level from the power control board is ok, the controlled stage transistor collector voltage will be within one volt of the dc supply voltage.

Step 12. If the controlled stage transistor voltage is normal, but the stage power output is low, the controlled stage is defective. It is assumed that the tripler/low-level amplifier tests earlier in this procedure have shown that the tripler/low-level amplifier is operating properly.

Step 13. After all malfunctions have been found and corrected and proper predriver power output can be obtained, disconnect the test coaxial cable and make sure all rf interstage connections are restored.

Step 14. Re-enable the "No Power" Protect circuit on the power control board by removing the jumper that was connected across C611 earlier in this procedure. Be sure none of the power control board plating is shorted. Reinstall the power control board shield.

Step 15. Reconnect the transmitter output coax to the antenna network. Make sure a properly-terminated rf wattmeter is connected to the transmitter output connector. The coaxial cable between the station and the wattmeter should be 8" or less in length.

Step 16. Key the transmitter. If adjusting the POWER SET control allows rated power to be obtained, do a complete POWER SET and Drive Limit control adjustment procedure. Refer to the TRANSMITTER ALIGNMENT section of this instruction manual. If rated power cannot be obtained, go on to the driver and final amplifier testing procedure.

4.3 DRIVER AND FINAL AMPLIFIER TESTING PROCEDURES

4.3.1 It is assumed that before you begin the following procedures you have determined that the predriver, controlled stage, tripler/low-level amplifier, and exciter are operating properly.

4.3.2 The driver and final amplifier stages may have one, two, or four transistors. These differing configurations require slightly different troubleshooting techniques. The procedure is therefore broken up according to the number of transistors used in the stage.

All driver and final amplifier stages:

Step 1. Connect an rf wattmeter to the transmitter output connector, using an 8-inch or shorter length of coaxial cable. Be sure the wattmeter is terminated in a 50-ohm resistive load.

Step 2. Disconnect the predriver output connection from the following stage. Connect the predriver output to the input of the antenna network, using an adapter cable.

Step 3. Connect a Motorola test set to the radio for Power Control Board metering.

PA STAGE POWER OUTPUT TABLE FOR INTERSTAGE TROUBLESHOOTING
(Minimum Values)

MODEL	POWER OUTPUT, WATTS (NOTE 1)				
	TRIPLER/ LOW-LEVEL AMPL	CONTROLLED STAGE	PRE-DRIVER	DRIVER	FINAL AMPL
406-420 MHz					
B/C34		4 W	16 W	NOT USED	NOT USED
B/C54		4 W	16 W	NOT USED	50 W
B/C64	(NOTE 2)	4 W	16 W	40 W	80 W
450-470 MHz					
B/C34		4 W	16 W	NOT USED	NOT USED
B/C44		4 W	16 W	NOT USED	27 W
B/C54		4 W	16 W	NOT USED	50 W
B/C64	(NOTE 2)	4 W	16 W	26 W	80 W
470-512 MHz					
B/C34		4 W	15 W	NOT USED	NOT USED
B/C44		4 W	15 W	NOT USED	24 W
B/C54		4 W	15 W	NOT USED	45 W
B/C64	(NOTE 2)	4 W	15 W	24 W	65 W

Note 1: These power levels take into account a 20% loss in the Antenna Network.
Note 2: Exciter meter 5 reading must be at least 20 uA. Tripler/low-level amplifier should have an output of 1 watt.

Step 4. Key the transmitter. Adjust the POWER SET control on the power control board until exactly the predriver output level listed in the PA stage power output table is obtained. Observe the test set meter 5 reading. Write down the reading for reference later in this procedure. Turn the POWER SET control fully counterclockwise.

Step 5. Disconnect the adapter cable from the predriver output and reconnect the predriver output to the driver or PA input.

Single-transistor stages:

Step 1. 20-watt power amplifier - Connect the final amplifier output coaxial cable to the antenna network input.

60- and 75-watt PA drivers - Disconnect the driver stage output from the final amplifier input. Connect the driver output to the antenna network input, using an adapter cable.

Step 2. Key the transmitter and adjust the POWER SET control for the same meter 5 reading recorded in step 4. If the stage power output is significantly less than the value given in the PA stage power output table, the stage is defective.

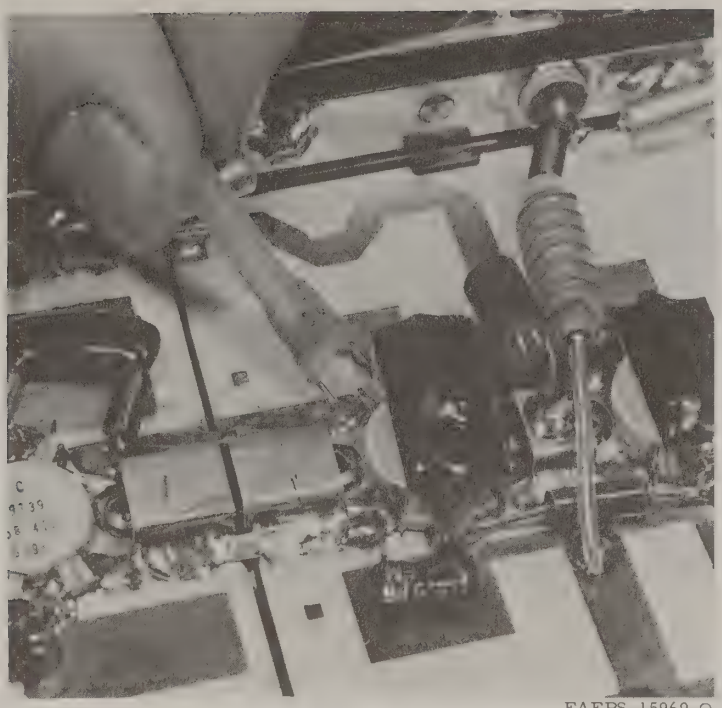
Two-transistor stages:

Step 1. 40- and 45-watt power amplifiers - Connect the final amplifier output cable to the antenna network input.

60- and 75-watt PA drivers - Disconnect the driver output from the final amplifier input. Connect the driver input to the antenna network input, using an adapter cable.

Step 2. Key the transmitter, adjust the POWER SET control for the same meter 5 reading recorded previously in step 4, and observe the wattmeter. Compare the wattmeter reading with the value given in the PA stage power output table. If the stage power output is less than 25% of the value given in the PA stage power output table, it is likely that both transistors are bad. If the stage output is greater than 25% of the value in the PA stage gain table, but still below rated power, it is probable that only one of the transistors is defective. The following procedure is a quick way to determine which transistor is bad: (Refer to Figure 1).

-- Trim the leads of a 10 pF NP0 disc ceramic capacitor to within 1/4-inch of the capacitor body. As shown in Figure 1, a length of



FAEPS-15969-O

Figure 1.
Capacitor Bridging Method of Testing PA Transistors

shrinkable tubing over the capacitor body will make handling easier.

-- One at a time, bridge each transistor base-emitter junction with the 10 pF capacitor while the transmitter is keyed. If the transistor is good, the power output of the stage will drop significantly (greater than 20%). If the transistor is bad, the stage power output will drop only slightly.

Four-transistor stages:

Step 1. 60- and 75-watt final amplifiers - Be sure the final amplifier output coaxial cable is connected to the antenna network input.

Step 2. Key the transmitter, adjust the POWER SET control for the same meter 5 reading recorded previously in step 4, and observe the wattmeter. Compare the wattmeter reading with the value given in the PA stage power output table. If the wattmeter reading is significantly below the value in the table, it is probable that one or more of the transistors is bad.

Step 3. To isolate the defective pair of transistors, alternately disconnect the chokes from each pair, key the transmitter, and observe the wattmeter. Disconnecting each choke should produce the same decrease in transmitter power output. The defective pair is the one that causes the least power output change when it is disabled.

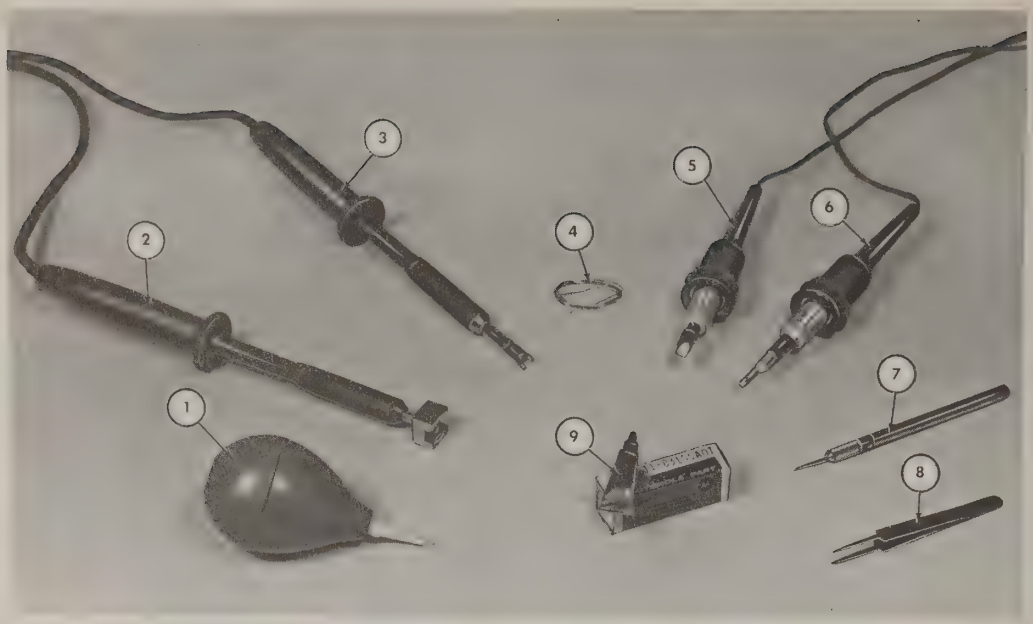
Step 4. After the pair that contains the defective transistor is identified, use the capacitor bridging method to determine which transistor of the pair is bad. The capacitor bridging technique is explained in the two-transistor stage testing section of this procedure.

4.4 POWER AMPLIFIER REPAIR PROCEDURES

4.4.1 Recommended Tools for PA Servicing

4.4.1.1 Because of the unique power amplifier construction it is recommended that the tools shown in Figure 2 be used during the repair procedures in this section. Except for the silver solder (item 4) and the Wakefield thermal compound (item 9), which are supplied with replacement transistors, use of these tools is not mandatory. You will find, however, that these tools will make quality power amplifier repairs easier to perform.

4.4.1.2 The soldering iron tips shown in Figure 3 are designed to make transistor removal and chip capacitor removal and replacement easier.



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ITEM NUMBER	DESCRIPTION	MOTOROLA PART NUMBER
1	Solder remover	ST-726
2	60-watt soldering iron	ST-1144
	Special tip for PA transistor removal	ST-1161
3	60-watt soldering iron	ST-1144
	Special tip for chip capacitor soldering	ST-1160
4	Silver solder; alloy content 1.4% silver, 36.1% lead, 62.5% tin	10-10041A61
5	50-watt soldering iron	ST-646
	1/4" chisel tip	ST-1174
6	50-watt soldering iron with 1/8" chisel tip	ST-648
7	Modeling knife	ST-1172
	5 extra modeling knife blades	ST-1173
8	Tweezers	ST-492
9	Wakefield thermal compound	11-83166A01

Figure 2.
Recommended Tools for Power Amplifier Repairs

FAEPS-15971-O

ITEM NUMBER	MOTOROLA PART NO.	APPLICATION
1	ST-1160	Chip capacitor removal and replacement
2	ST-1161	PA transistor removal

Figure 3.
Special Soldering Iron Tips for PA Servicing

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Figure 4.
Examples of Leached Chip Capacitors

4.4.2 Visual Inspection

4.4.2.1 After the malfunctioning stage has been identified, perform a thorough physical inspection before beginning repairs.

4.4.2.2 Check the ceramic substrate for hairline cracks. Hairline cracks can often be found by running a sharp instrument along the ceramic beside the microstrip conductors. Check in BOTH directions. A crack will usually "catch" the instrument, even when the crack is too small to be seen. Broken microstrip conductors can also be found through ohmmeter continuity checks.

4.4.2.3 Look for "leached" chip capacitors. Figure 4 shows examples of typical leaching of chip capacitor end metallization. Leaching is most often evidenced by failure of the chip capacitor end metallization to take solder. In severe cases the stacked plates inside the capacitor may be visible.

4.4.2.4 If no defects are found, proceed with repairs to the defective stage.

4.4.3 Power Amplifier Transistor Removal

Step 1. As shown in Figure 5, unsolder all component connections at or near the points where the rf power transistor leads are soldered to the microstrip.

Step 2. Chip capacitors are connected between rf power transistor leads. Remove all four chip capacitors, using two soldering irons, as shown in Figure 6A, or the special soldering iron tip (Motorola Part No. ST-1160), as shown in Figure 6B.

CAUTION

Chip capacitors must not be re-used. Excessive heat applied during capacitor removal can cause leaching of the metallic contact area.

Step 3. Remove the two ground straps that cover the transistor mounting screws. See Figure 7.

Step 4. Remove excess solder from the transistor lead area with a vacuum-bulb solder remover.

Step 5. Carefully lift each of the four rf power transistor emitter leads. Use a modeling knife blade or long-nosed pliers to lift each emitter lead while applying heat, as shown in Figure 8. Be sure the solder has melted before you try to lift the lead, but avoid prolonged or excessive heating.

Step 6. Remove the transistor mounting screws.

Step 7. Alternately lift the base and the collector leads. Use a modeling knife blade or long-nosed pliers to lift a lead while applying heat, as shown in Figure 9. Be sure the solder has melted before you try to lift a lead, but avoid prolonged or excessive heating. All six power transistor leads can be desoldered simultaneously using a Motorola ST-1161 soldering iron tip on a 90-watt iron. See Figure 10. Grasp a transistor mounting lug with long-nosed pliers as shown, and as soon as the solder melts, remove the soldering iron and lift the transistor out.

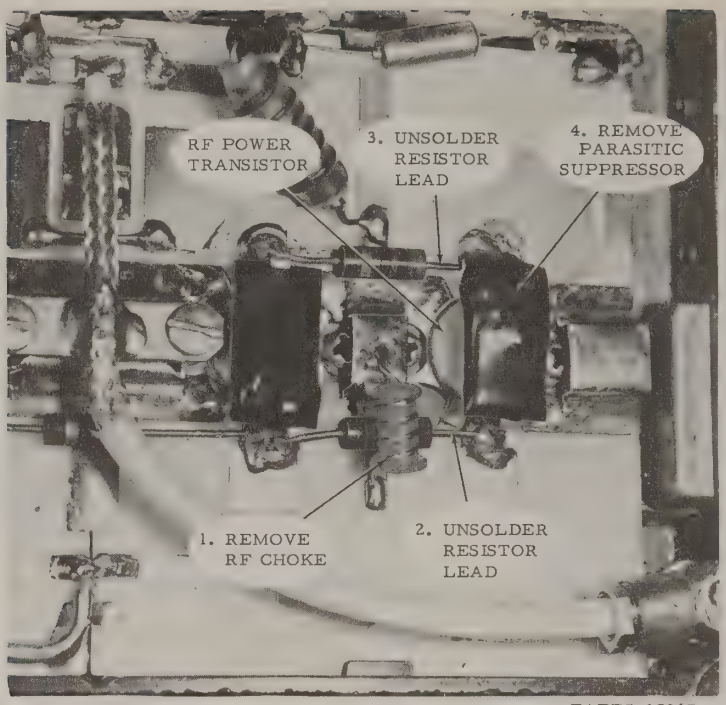

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Figure 5.
Component Removal Procedure (Typical)

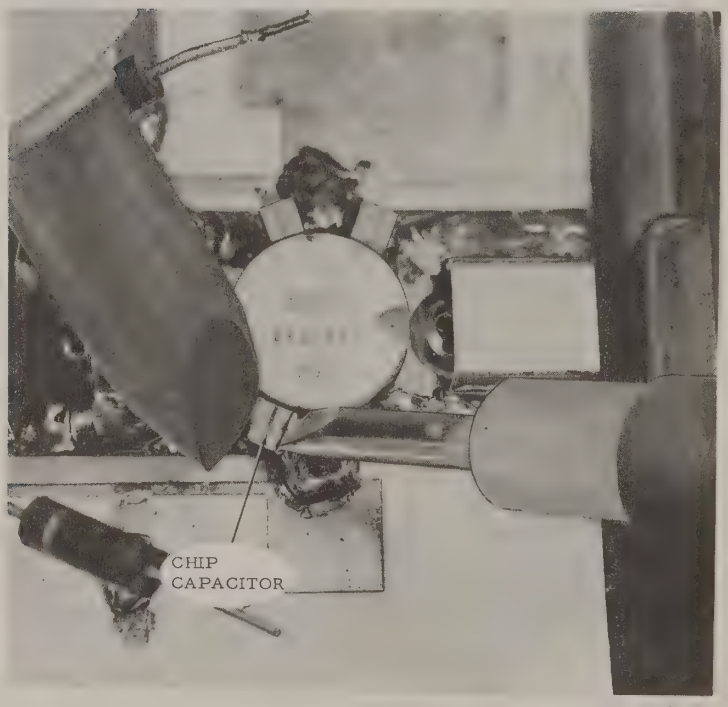

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Figure 6A.
Chip Capacitor Removal Using Two Soldering Irons

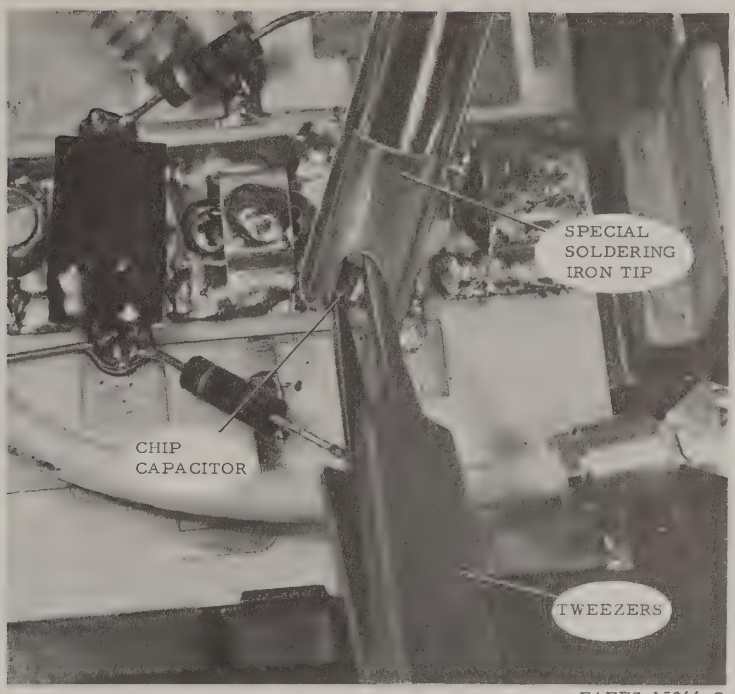

Figure 6B.
Chip Capacitor Removal Using ST-1160 Soldering Iron Tip

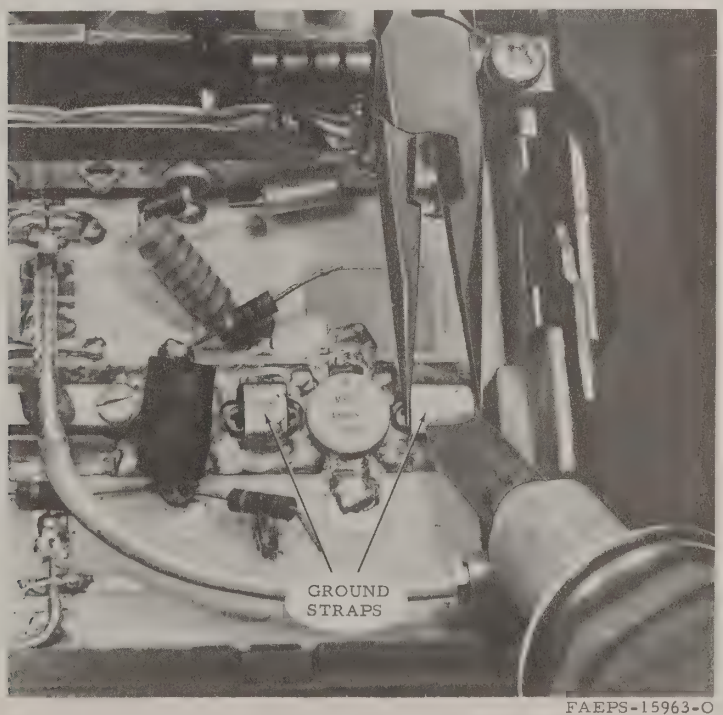

Figure 7.
Ground Strap Removal

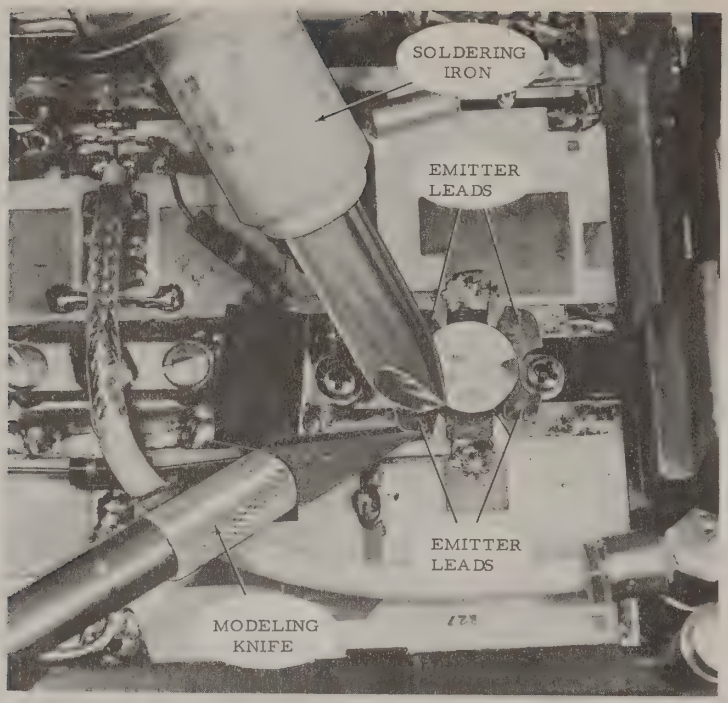

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Figure 8.
Disconnecting Power Transistor Emitter Leads

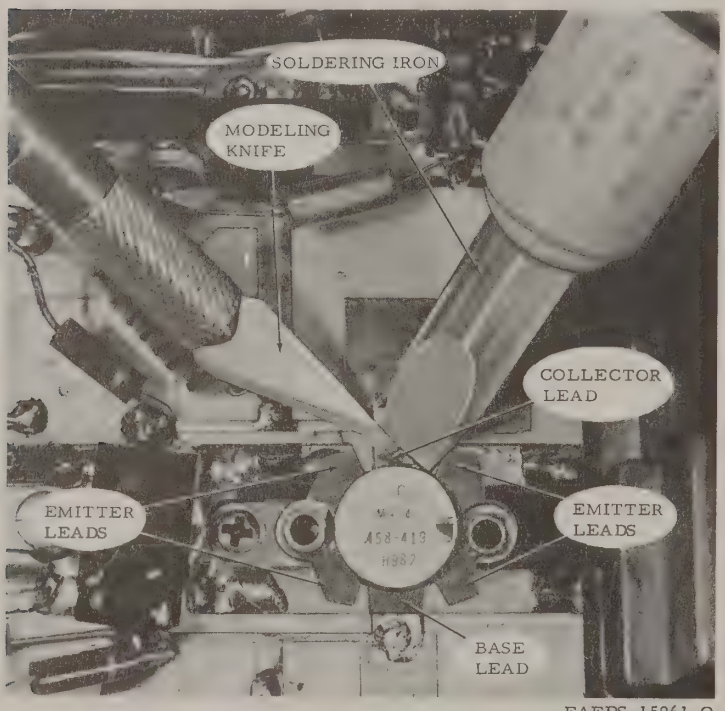

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Figure 9.
Disconnecting the Power Transistor Base and Collector Leads

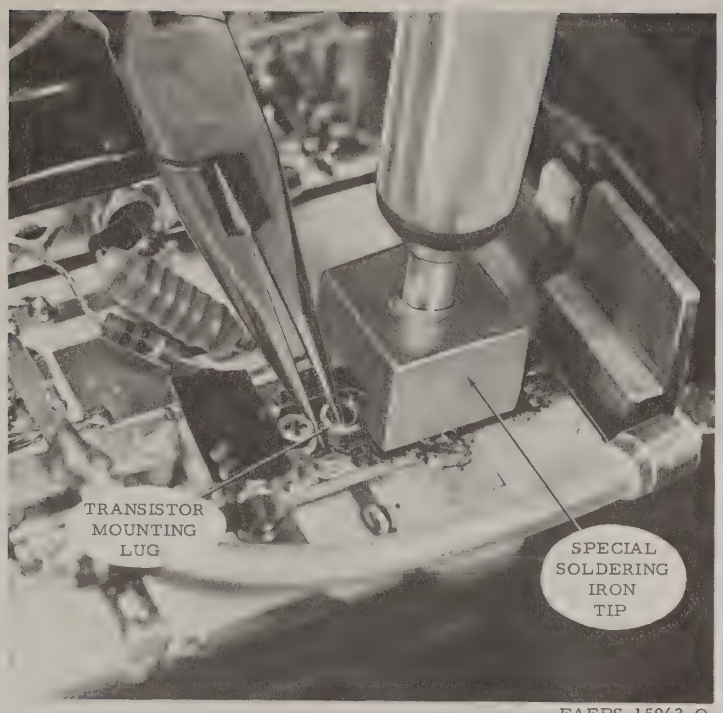


Figure 10.
Power Transistor Removal, Using ST-1161 Soldering Iron Tip

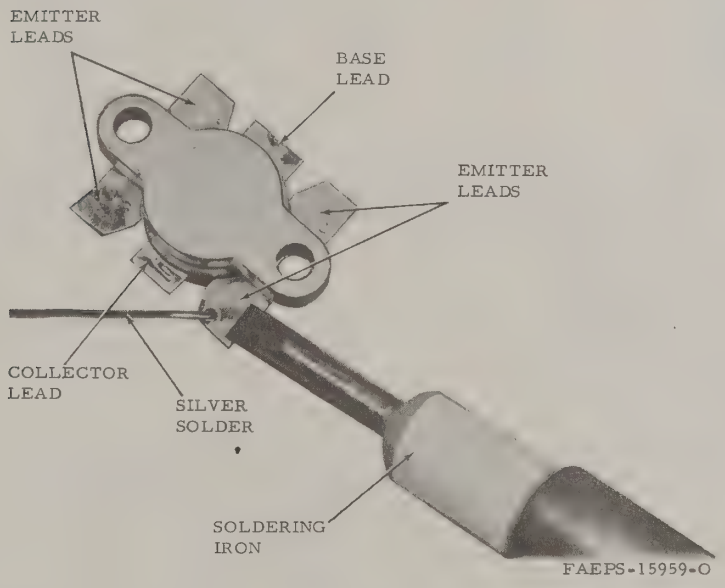


Figure 11.
Pre-Tinning Power Transistor Leads

NOTE

The ST-1161 soldering iron tip should not be used to replace transistors.

4.4.4 Power Transistor Replacement

Step 1. Lightly pre-tin the underside of each transistor lead. See Figure 11.

CAUTION

When pre-tinning the transistor leads do not allow thick build-ups of solder to occur. Such a build-up could cause the transistor to separate from its mounting base when the mounting screws are tightened. Avoid getting solder or flux on the transistor mounting base.

Step 2. Thoroughly clean the transistor mounting surface, using alcohol or another solvent that leaves no residue. Apply a light coat of Wakefield Thermal Compound (Motorola Part No. 11-83166A01) to the mounting surface (bottom side of the transistor). See Figure 12.

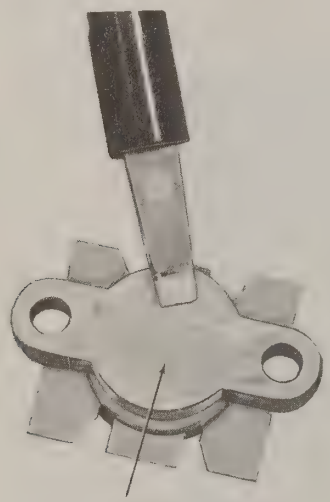


Figure 12.
Application of Wakefield Thermal Compound to Transistor Mounting Surface

CAUTION

Thick coatings of thermal compound or foreign material on the transistor mounting surface will cause poor thermal contact and may result in early transistor failure.

Step 3. Mount the transistor. Be sure the collector lead, marked "C" on the transistor cap, faces the proper direction. Refer to Figure 13.

Step 4. Carefully tighten the transistor mounting screws. Figure 14 shows proper transistor positioning before the leads are soldered to the microstrip.

CAUTION

To avoid damage to the transistor or the microstrip, the transistor mounting screws MUST be tightened before the transistor leads are soldered to the microstrip conductors. Do not tighten mounting screws too much or thread stripping in the heatsink will result.

Step 5. Solder each transistor lead, one at a time, to the microstrip. Use the silver solder (Motorola Part No. 10-10041A61) supplied with the replacement transistors. The use of a generous amount of the solder will insure a good contact over the entire area of the transistor tab and microstrip interface, and will assist in the reflow soldering of the chip capacitors. Use care that the solder does not bridge the leads or short either the base or collector leads to the microstrip ground. See Figure 15.

Step 6. Install the chip capacitors supplied with the power transistor. Use a low-wattage soldering iron (50 watts or less) with a chisel tip (Figure 16A) or a 60 watt iron with a ST-1160 tip (Figure 16B). A reflow-type technique MUST be used and the soldering iron tip MUST NOT be allowed to touch the chip capacitor end termination. Make sure the chip capacitor is placed as close to the transistor cap as possible, as shown in Figures 16A and 16B.

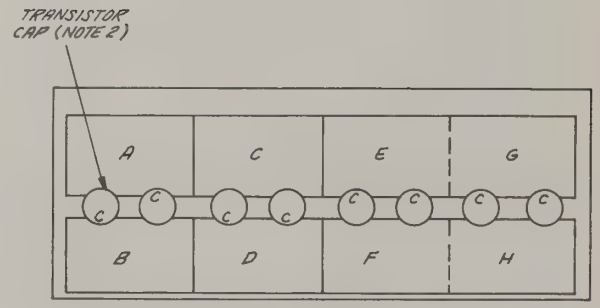
CAUTION

Proper soldering technique and chip capacitor placement are essential to acceptable transmitter operation. Use extreme care when replacing chip capacitors.

Step 7. Check the chip capacitor solder connections. The solder should cover the entire capacitor end termination. If the solder adheres to only the lower portion of the end termination, as illustrated in Figures 17A and 17B, assume that the capacitor end termination metallization is leached. The capacitor must be replaced if

POWER AMPLIFIER MICROSTRIP CROSS REFERENCE TABLE

LOCATION	RADIO MODEL	FREQUENCY RANGE (MHz)	MICROSTRIP PART NO.
A	B/C34	406–420	1V80775B48
	B/C54/64	406–420	1V80769B98
	B/C34	450–470	1V80775B63
	B/C44,54,64	450–512	1V80769B98
	B/C34	470–512	1V80775B48
B	B/C34	406–420	1V80769B99
	B/C54,64	406–420	1V80769B99
	B/C34	450–470	1V80775B62
	B/C44,54,64	450–512	1V80769B99
	B/C34	470–512	1V80769B99
C	B/C54,64	406–420	1V80754B03
	B/C44,64	450–512	1V80739B15
	B/C54	450–512	1V80739B11
D	B/C54	406–420	1V80754B04
	B/C64	406–420	1V80754B09
	B/C44	450–512	1V80739B35
	B/C55	450–512	1V80739B12
	B/C64	450–512	1V80739B16
E	B/C64	406–420	1V80754B06
	B/C64	450–470	1V80793B53
	B/C64	470–512	1V80793B55
F	B/C64	406–420	1V80754B05
	B/C64	450–512	1V80739B27
G	B/C64	406–420	1V80754B08
	B/C64	450–470	1V80993B54
	B/C64	470–512	1V80793B56
H	B/C64	406–420	1V80754B07
	B/C64	450–512	1V80739B28



NOTES:

1. REFER TO CROSS–REFERENCE TABLE FOR PART NO. OF MICROSTRIP CIRCUITS ACCORDING TO LOCATION FOR VARIOUS RADIO MODELS.
2. "C" ON TRANSISTOR CAPS INDICATES PLACEMENT OF COLLECTOR LEAD.

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Figure 13.
Microstrip Location and Power Transistor Placement Detail

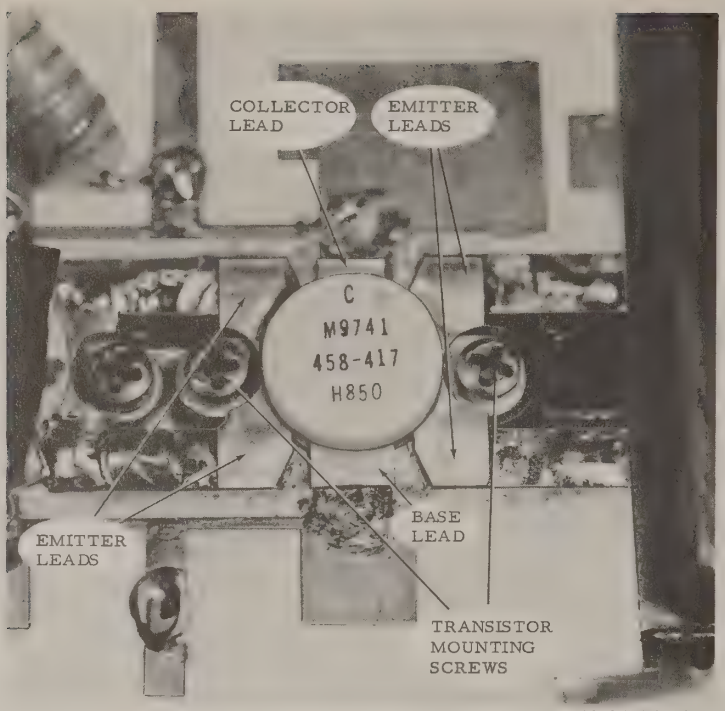

Figure 14.
Power Transistor Placement

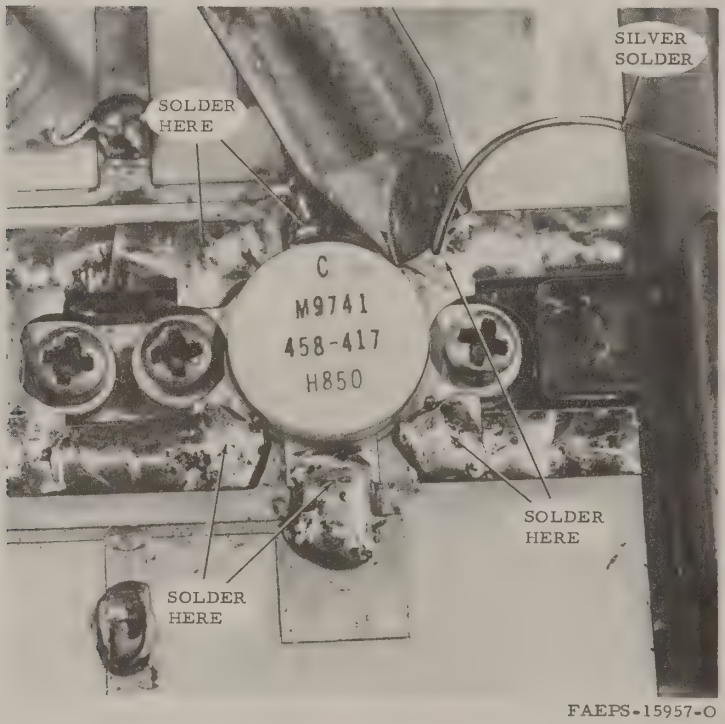

Figure 15.
Soldering Power Transistor Leads to the Microstrip

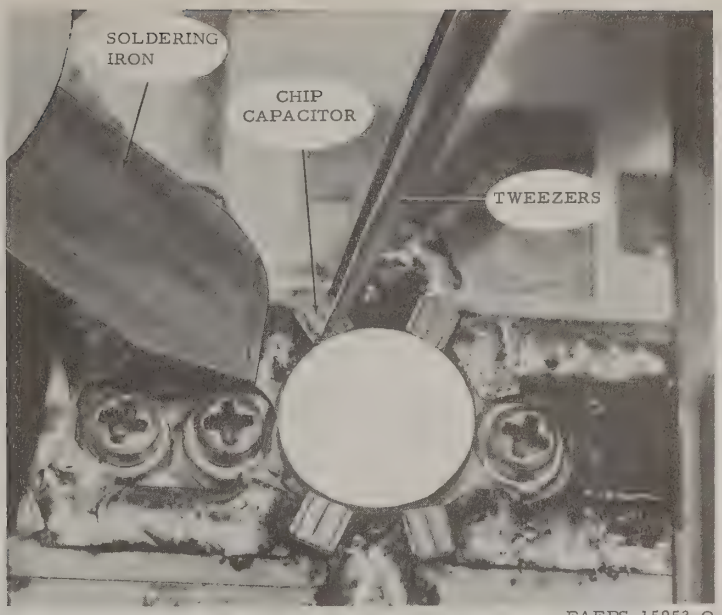

Figure 16A.
Chip Capacitor Installation, Using a 50-Watt Soldering Iron with a Chisel Tip

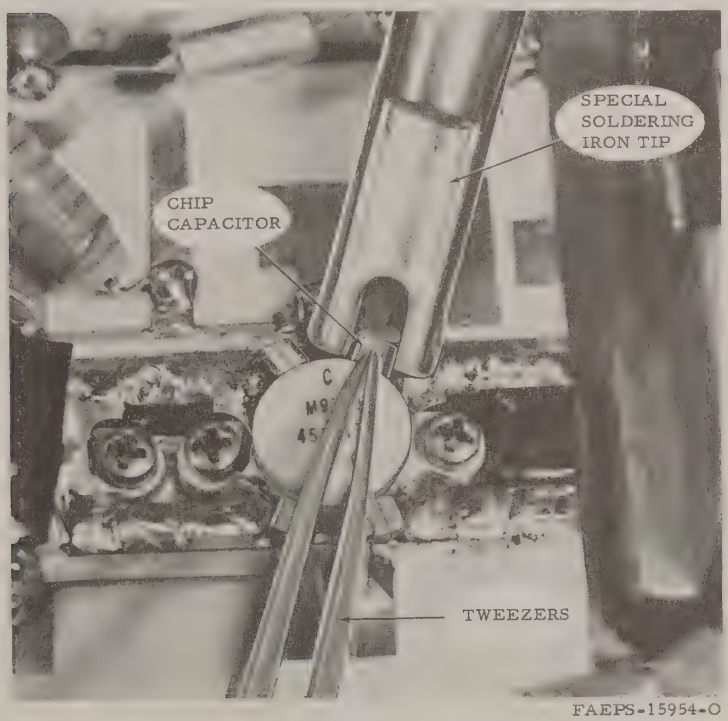

Figure 16B.
Chip Capacitor Installation, Using a 60-Watt Soldering Iron with ST-1160 Tip

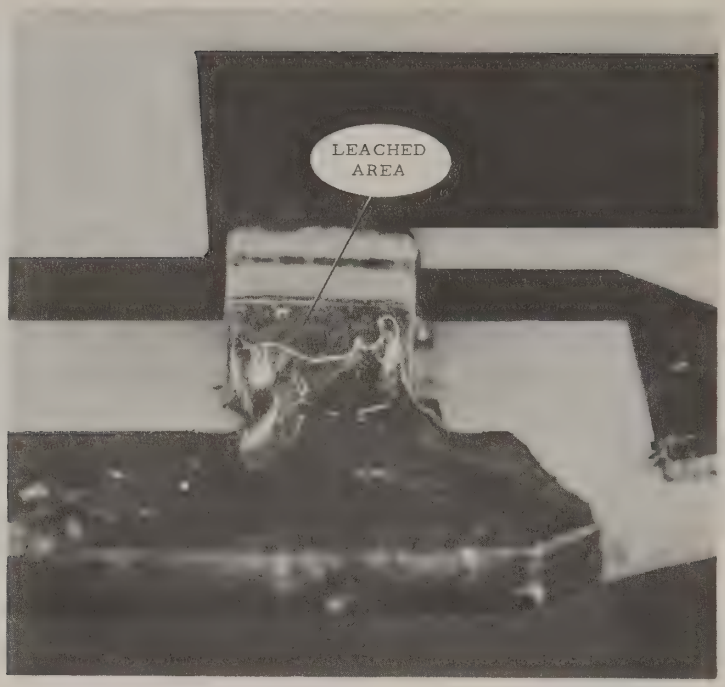

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Figure 17A.

Appearance of Leached Chip Capacitor on Microstrip

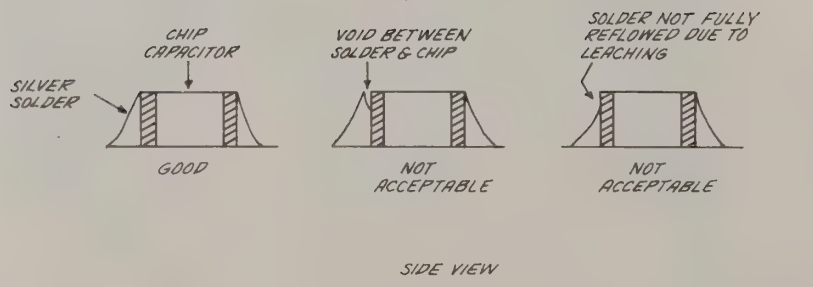

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Figure 17B.
Chip Capacitor Soldering

TROUBLESHOOTING PREREQUISITES:

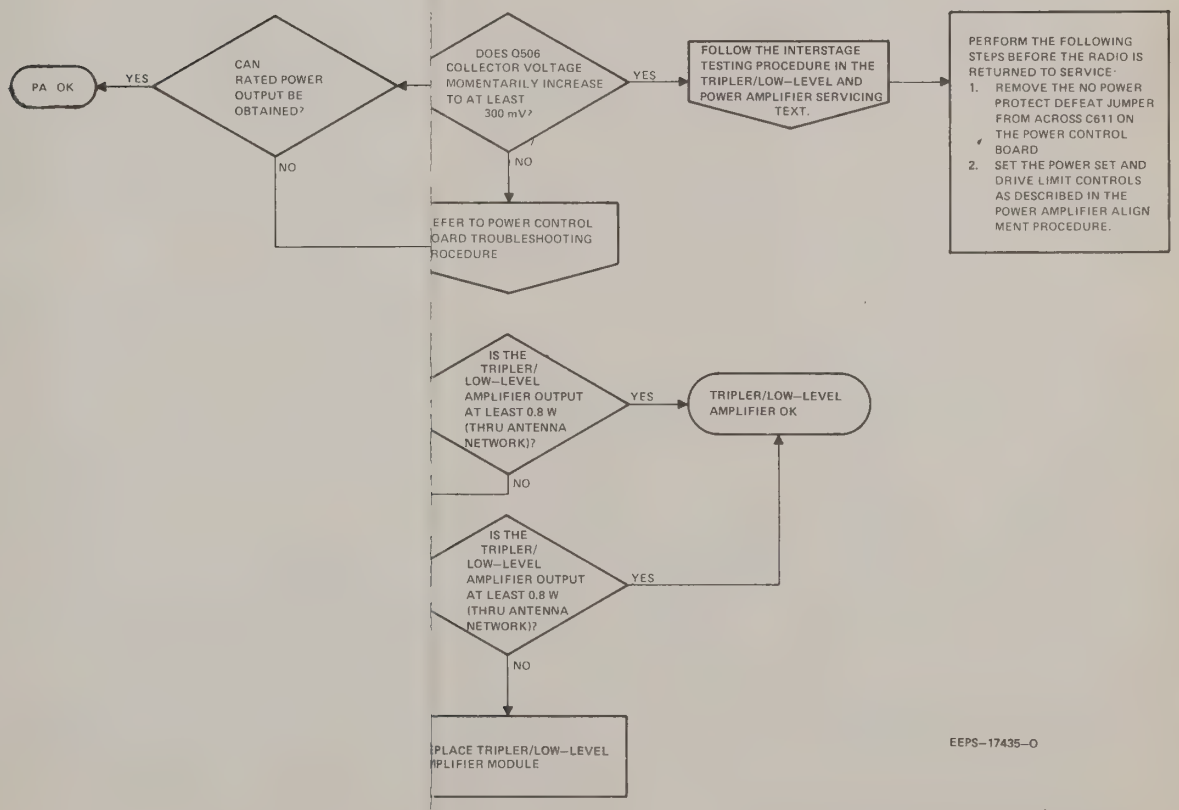
1. CONNECT THE RADIO ANTENNA CONNECTOR TO A WATTMETER THAT IS TERMINATED IN A 50–WATT DUMMY LOAD. BE SURE THE WATTMETER AND DUMMY LOAD ARE RATED FOR UHF USE.
2. USING A TEK–37 ADAPTER CABLE, CONNECT A MOTOROLA PORTABLE TEST SET TO THE RADIO AS FOLLOWS:
   A. CONNECT THE 20–PIN CONNECTOR OF THE ADAPTER CABLE TO THE RECEPTACLE ON THE FRONT OF THE PORTABLE TEST SET.
   B. CONNECT THE ADAPTER CABLE RED "CONTROL" PLUG TO THE CONTROL RECEPTACLE (J3) ON THE UNIFIED CHASSIS INTERCONNECT BOARD.
   C. CONNECT THE ADAPTER CABLE WHITE "METERING" PLUG TO THE PA METERING RECEPTACLE.
3. SET THE PORTABLE TEST SET SWITCHES AS FOLLOWS:
   A. SET THE FUNCTION SWITCH TO THE XMTR POSITION.
   B. SET THE METER SWITCH TO THE OFF POSITION.
   C. SET THE ADAPTER CABLE REF SWITCH TO POSITION A.
   D. SET THE ADAPTER CABLE 1 V–100 mV SWITCH TO THE 100 mV POSITION. IF THE ADAPTER CABLE HAS NO SUCH SWITCH, THE UNIT OPERATES AT 100 mV AT ALL TIMES.
   E. SET THE TEST SET SELECTOR SWITCH AS REQUIRED BY THE PROCEDURE.
4. USING BUILT–IN STATION METERING, CONNECT THE "CONTROL" PLUG TO THE CONTROL RECEPTACLE (J3) ON THE UNIFIED CHASSIS INTERCONNECT BOARD. ALSO, CONNECT THE METERING PLUG TO THE PA METERING RECEPTACLE.
5. REMOVE THE POWER CONTROL BOARD SHIELD AND TURN THE DRIVE LIMIT CONTROL TO MINIMUM (FULLY COUNTERCLOCKWISE).
6. BE SURE ALL AC–OPERATED TEST EQUIPMENT IS ISOLATED FROM AC LINE GROUND.
7. EACH TIME THE POWER SET CONTROL IS ADJUSTED, THE TRANSMITTER MUST BE DE–KEYED AND AGAIN KEYED SO THAT THE POWER CONTROL BOARD COMES OUT OF THE "SHUTBACK" CONDITION.

OOTING CHART

TABLE I
MINIMUM PA METER READINGS

RADIO SET MODEL	MINIMUM METER READING, uA	CIRCUIT METERED
B/C44	20	PREDRIVER DC CURRENT (NOTE 1)
B/C54	15	
B/C74	25	
B/C44	NOT USED	DRIVER DC CURRENT
B/C54	15	
B/C74	25	
B/C44 B/C54 B/C64	WHEN XMTR IS KEYED, READING SHOULD DECREASE, BUT BE AT LEAST 5 uA.	VOLTAGE DIFFERENCE BETWEEN A+ AND VOLTAGE AT CONTROLLED STAGE.

LL CAUSE METER TO PIN AT MAXIMUM.


PA OK
YES
CAN RATED POWER OUTPUT BE OBTAINED?
NO
DOES Q506 COLLECTOR VOLTAGE MOMENTARILY INCREASE TO AT LEAST 300 mV?
YES
NO
FOLLOW THE INTERSTAGE TESTING PROCEDURE IN THE TRIPLER/LOW–LEVEL AND POWER AMPLIFIER SERVICING TEXT.
PERFORM THE FOLLOWING STEPS BEFORE THE RADIO IS RETURNED TO SERVICE:
1. REMOVE THE NO POWER PROTECT DEFEAT JUMPER FROM ACROSS C611 ON THE POWER CONTROL BOARD
2. SET THE POWER SET AND DRIVE LIMIT CONTROLS AS DESCRIBED IN THE POWER AMPLIFIER ALIGNMENT PROCEDURE.
EFER TO POWER CONTROL OARD TROUBLESHOOTING ROCEDURE
IS THE TRIPLER/LOW–LEVEL AMPLIFIER OUTPUT AT LEAST 0.8 W (THRU ANTENNA NETWORK)?
YES
TRIPLER/LOW–LEVEL AMPLIFIER OK
NO
IS THE TRIPLER/LOW–LEVEL AMPLIFIER OUTPUT AT LEAST 0.8 W (THRU ANTENNA NETWORK)?
YES
NO
PLACE TRIPLER/LOW–LEVEL MPLIFIER MODULE

EEPS–17435–O

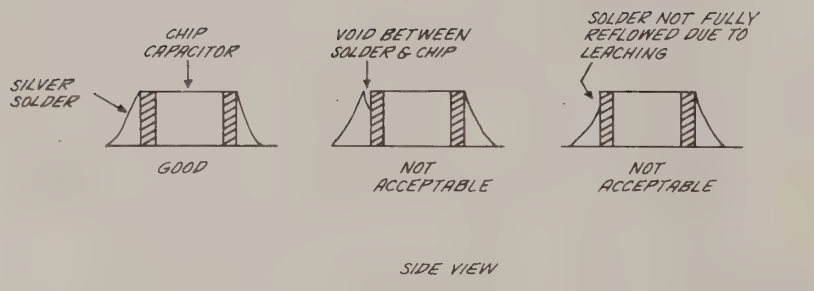
PA TROUBLESHOOTING CHART

PA Troubleshooting Chart
Motorola No. EEPS-17435-O
4/11/75-UP

FAEPS-15974-O

Figure 17A.

Appearance of Leached Chip Capacitor on Microstrip



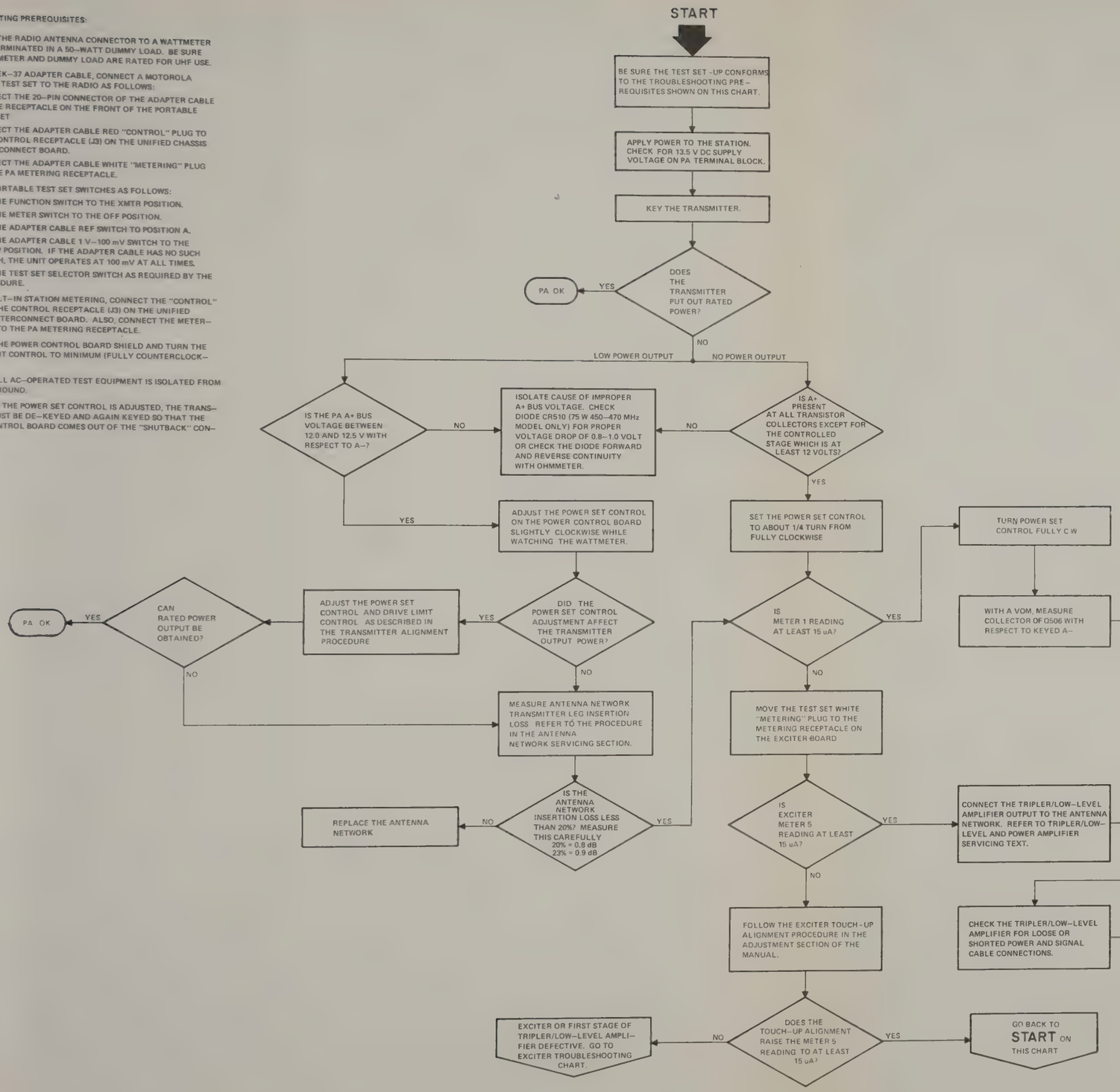
AEPS-17749-D

Figure 17B.
Chip Capacitor Soldering

PA TROUBLESHOOTING CHART

TROUBLESHOOTING PREREQUISITES:

1. CONNECT THE RADIO ANTENNA CONNECTOR TO A WATTMETER THAT IS TERMINATED IN A 50–WATT DUMMY LOAD. BE SURE THE WATTMETER AND DUMMY LOAD ARE RATED FOR UHF USE.
2. USING A TEK–37 ADAPTER CABLE, CONNECT A MOTOROLA PORTABLE TEST SET TO THE RADIO AS FOLLOWS:
   A. CONNECT THE 20–PIN CONNECTOR OF THE ADAPTER CABLE TO THE RECEPTACLE ON THE FRONT OF THE PORTABLE TEST SET
   B. CONNECT THE ADAPTER CABLE RED "CONTROL" PLUG TO THE CONTROL RECEPTACLE (J3) ON THE UNIFIED CHASSIS INTERCONNECT BOARD.
   C. CONNECT THE ADAPTER CABLE WHITE "METERING" PLUG TO THE PA METERING RECEPTACLE.
3. SET THE PORTABLE TEST SET SWITCHES AS FOLLOWS:
   A. SET THE FUNCTION SWITCH TO THE XMTR POSITION.
   B. SET THE METER SWITCH TO THE OFF POSITION.
   C. SET THE ADAPTER CABLE REF SWITCH TO POSITION A.
   D. SET THE ADAPTER CABLE 1 V–100 mV SWITCH TO THE 100 mV POSITION. IF THE ADAPTER CABLE HAS NO SUCH SWITCH, THE UNIT OPERATES AT 100 mV AT ALL TIMES.
   E. SET THE TEST SET SELECTOR SWITCH AS REQUIRED BY THE PROCEDURE.
4. USING BUILT–IN STATION METERING, CONNECT THE "CONTROL" PLUG TO THE CONTROL RECEPTACLE (J3) ON THE UNIFIED CHASSIS INTERCONNECT BOARD. ALSO, CONNECT THE METERING PLUG TO THE PA METERING RECEPTACLE.
5. REMOVE THE POWER CONTROL BOARD SHIELD AND TURN THE DRIVE LIMIT CONTROL TO MINIMUM (FULLY COUNTERCLOCKWISE).
6. BE SURE ALL AC–OPERATED TEST EQUIPMENT IS ISOLATED FROM AC LINE GROUND.
7. EACH TIME THE POWER SET CONTROL IS ADJUSTED, THE TRANSMITTER MUST BE DE–KEYED AND AGAIN KEYED SO THAT THE POWER CONTROL BOARD COMES OUT OF THE "SHUTBACK" CONDITION.


START
BE SURE THE TEST SET -UP CONFORMS TO THE TROUBLESHOOTING PRE–REQUISITES SHOWN ON THIS CHART.
APPLY POWER TO THE STATION. CHECK FOR 13.5 V DC SUPPLY VOLTAGE ON PA TERMINAL BLOCK.
KEY THE TRANSMITTER.
DOES THE TRANSMITTER PUT OUT RATED POWER?
YES
PA OK
NO
LOW POWER OUTPUT
NO POWER OUTPUT
IS THE PA A+ BUS VOLTAGE BETWEEN 12.0 AND 12.5 V WITH RESPECT TO A–?
NO
ISOLATE CAUSE OF IMPROPER A+ BUS VOLTAGE. CHECK DIODE CR510 (75 W 450–470 MHz MODEL ONLY) FOR PROPER VOLTAGE DROP OF 0.8–1.0 VOLT OR CHECK THE DIODE FORWARD AND REVERSE CONTINUITY WITH OHMMETER.
IS A+ PRESENT AT ALL TRANSISTOR COLLECTORS EXCEPT FOR THE CONTROLLED STAGE WHICH IS AT LEAST 12 VOLTS?
NO
YES
YES
ADJUST THE POWER SET CONTROL ON THE POWER CONTROL BOARD SLIGHTLY CLOCKWISE WHILE WATCHING THE WATTMETER.
SET THE POWER SET CONTROL TO ABOUT 1/4 TURN FROM FULLY CLOCKWISE
DID THE POWER SET CONTROL ADJUSTMENT AFFECT THE TRANSMITTER OUTPUT POWER?
YES
NO
IS METER 1 READING AT LEAST 15 uA?
YES
NO
ADJUST THE POWER SET CONTROL AND DRIVE LIMIT CONTROL AS DESCRIBED IN THE TRANSMITTER ALIGNMENT PROCEDURE
YES
CAN RATED POWER OUTPUT BE OBTAINED?
YES
PA OK
NO
MEASURE ANTENNA NETWORK TRANSMITTER LEG INSERTION LOSS REFER TO THE PROCEDURE IN THE ANTENNA NETWORK SERVICING SECTION.
MOVE THE TEST SET WHITE "METERING" PLUG TO THE METERING RECEPTACLE ON THE EXCITER BOARD
IS THE ANTENNA NETWORK INSERTION LOSS LESS THAN 20%? MEASURE THIS CAREFULLY 20% = 0.8 dB 23% = 0.9 dB
NO
REPLACE THE ANTENNA NETWORK
YES
IS EXCITER METER 5 READING AT LEAST 15 uA?
YES
NO
FOLLOW THE EXCITER TOUCH-UP ALIGNMENT PROCEDURE IN THE ADJUSTMENT SECTION OF THE MANUAL.
DOES THE TOUCH–UP ALIGNMENT RAISE THE METER 5 READING TO AT LEAST 15 uA?
NO
EXCITER OR FIRST STAGE OF TRIPLER/LOW–LEVEL AMPLIFIER DEFECTIVE. GO TO EXCITER TROUBLESHOOTING CHART.
YES
GO BACK TO START ON THIS CHART
TURN POWER SET CONTROL FULLY C W
WITH A VOM, MEASURE COLLECTOR OF Q506 WITH RESPECT TO KEYED A–
MOMENTARILY KEY TRANSMITTER.
DOES Q506 COLLECTOR VOLTAGE MOMENTARILY INCREASE TO AT LEAST 300 mV?
YES
NO
REFER TO POWER CONTROL BOARD TROUBLESHOOTING PROCEDURE
FOLLOW THE INTERSTAGE TESTING PROCEDURE IN THE TRIPLER/LOW–LEVEL AND POWER AMPLIFIER SERVICING TEXT.
PERFORM THE FOLLOWING STEPS BEFORE THE RADIO IS RETURNED TO SERVICE:
1. REMOVE THE NO POWER PROTECT DEFEAT JUMPER FROM ACROSS C611 ON THE POWER CONTROL BOARD
2. SET THE POWER SET AND DRIVE LIMIT CONTROLS AS DESCRIBED IN THE POWER AMPLIFIER ALIGNMENT PROCEDURE.
CONNECT THE TRIPLER/LOW–LEVEL AMPLIFIER OUTPUT TO THE ANTENNA NETWORK. REFER TO TRIPLER/LOW–LEVEL AND POWER AMPLIFIER SERVICING TEXT.
KEY THE TRANSMITTER.
IS THE TRIPLER/LOW–LEVEL AMPLIFIER OUTPUT AT LEAST 0.8 W (THRU ANTENNA NETWORK)?
YES
TRIPLER/LOW–LEVEL AMPLIFIER OK
NO
CHECK THE TRIPLER/LOW–LEVEL AMPLIFIER FOR LOOSE OR SHORTED POWER AND SIGNAL CABLE CONNECTIONS.
KEY THE TRANSMITTER.
IS THE TRIPLER/LOW–LEVEL AMPLIFIER OUTPUT AT LEAST 0.8 W (THRU ANTENNA NETWORK)?
YES
NO
REPLACE TRIPLER/LOW–LEVEL AMPLIFIER MODULE

EEPS–17435–O

TABLE I
MINIMUM PA METER READINGS

TEST SET SELECTOR SWITCH POSITION	ADAPTER CABLE REFERENCE SWITCH AND TEST SET METER–REV SWITCH POSITION	RADIO SET MODEL	MINIMUM METER READING, uA	CIRCUIT METERED
1	A OR B OFF	B/C44	20	PREDRIVER DC CURRENT (NOTE 1)
		B/C54	15	
		B/C74	25	
2	A OR B OFF	B/C44	NOT USED	DRIVER DC CURRENT
		B/C54	15	
		B/C74	25	
5	A OR B OFF	B/C44 B/C54 B/C64	WHEN XMTR IS KEYED, READING SHOULD DE–CREASE, BUT BE AT LEAST 5 uA.	VOLTAGE DIFFERENCE BETWEEN A+ AND VOLTAGE AT CONTROLLED STAGE.

NOTES:
1. OPEN METERING RESISTOR WILL CAUSE METER TO PIN AT MAXIMUM.

PA TROUBLESHOOTING CHART

PA Troubleshooting Chart
Motorola No. EEPS-17435-O
4/11/75-UP

the radio transmitter is to function properly. Remember that the leaching is probably the result of allowing the soldering iron to touch the chip capacitor end termination.

4.5 MICROSTRIP REMOVAL

Step 1. Remove all transistors as described in the previous instructions.

Step 2. Remove all external component connections to the microstrip, including interface connections with other stages.

Step 3. Remove all remaining ground straps (if any).

Step 4. Lift the microstrip substrate out of the plastic holder.

4.6 MICROSTRIP REPLACEMENT

Figure 13 provides location information for the eight microstrip boards. On the figure, each board is keyed with a letter identification. The letter is cross-referenced on the table to determine the microstrip board part number used for the various models of the radio.

NOTE

Microstrips cannot be ordered as complete kits. Each part must be ordered by its individual part number. When ordering a new microstrip be sure to order new chip capacitors, including those that are associated with the rf power transistors. Used chip capacitors must not be reused.

Step 1. Place the new microstrip substrate into the plastic holder. Refer to Figure 13 for location of the microstrip in the transmitter power amplifier assembly.

Step 2. Carefully clean all solder build-up off the transistor leads. Only a very thin layer of solder should remain. Check for solder-bridge shorts between transistor leads.

Step 3. Using silver solder (Motorola Part No. 10-10041A61), install the transistors and their associated chip capacitors as described in the power transistor replacement procedure. BE SURE YOU CAREFULLY TIGHTEN THE TRANSISTOR MOUNTING SCREWS BEFORE YOU SOLDER THE TRANSISTOR LEADS TO THE MICROSTRIP CONDUCTORS.

Step 4. Reconnect all external components to their proper locations on the microstrip.

5. POWER CONTROL BOARD MAINTENANCE

CAUTION

The power control board is incorporated in the transmitter to provide protection for the rf power transistors under environmental conditions such as voltage, load variation, and device variations. In order for the circuitry to operate properly and provide protection it is necessary to set the power output controls (Drive Limit and Power Set) in accordance with the Transmitter Alignment Procedure.

5.1 INTRODUCTION

This paragraph provides maintenance shop procedures for the power control circuitry. It is assumed that preliminary tests have already localized the trouble to the power control board. These bench test type procedures include measurements with a Motorola portable test set, a simple set of performance tests, and complete troubleshooting procedures.

NOTE

The power control board must be installed in a transmitter for testing to provide the necessary power, ground, and control connections. For bench testing of a board that has been removed from the radio set and replaced by a spare, another radio set is required as a test fixture for troubleshooting.

5.2 PERFORMANCE TESTS

5.2.1 POWER SET Control Test

This control allows the power output of the transmitter to be varied from zero (0) power out with the control fully counterclockwise to greater than the rated output.

CAUTION

For proper operation of the protection circuitry, it is imperative that the POWER SET control never be left in a position that exceeds rated power output.

Refer to the Power Amplifier Power Set Procedure in the Transmitter Alignment Section of this manual.

Step 1. Key the transmitter.

Step 2. Adjust the POWER SET control until the rated power output is reached.

Step 3. Unkey the transmitter.

5.2.2 Automatic Power Leveling Test

A separate variable voltage dc power supply must be used to perform this test.

Step 1. Disconnect the 13.6 volt lead at the PA. Connect a 16 volt source to the PA in its place. Set the power supply output to +13.6 volts.

Step 2. Key the transmitter.

Step 3. Vary the supply voltage from +13.6 volts to +16 volts. The transmitter output change should be between +10% and -5%.

Step 4. Unkey the transmitter and reconnect the PA to the station's power supply.

5.2.3 Drive Limit Control

5.2.3.1 This control allows the drive power to the power amplifier from the controlled stage to be limited to a level sufficient to provide rated performance. Its purpose is to set a limit on the drive power that can be called for by the automatic power leveling circuitry. This prevents earlier PA stages from being damaged by overdrive if later stages fail. Depending on the position of the Drive Limit control, the maximum collector voltage of the controlled stage can be limited to between 6.5 volts and 12.5 volts. The proper procedure for setting the Drive Limit control is given in the Transmitter Alignment Procedure under the Power Amplifier Power Setting Section.

CAUTION

For proper operation of the power leveling circuitry, the Drive Limit control must not be set for any lower power output than that given in the Drive Limit column in Table 1 of the Power Setting Section.

5.2.3.2 In stations with high gain driver and power amplifier stages, the power leveling power set circuitry may operate the controlled stage at a collector voltage less than 6.5 volts. In such stations, little or no effect will be seen from the Drive Limit control. If it is not possible to lower power output by the Drive Limit control to the level called for in the alignment procedure, set the Drive Limit control to its maximum clockwise position (maximum drive limit).

5.2.3.3 In some stations the rf drive reserve is not sufficient to require use of the Drive Limit control. In these stations power output level called for in the power control board alignment procedure cannot be obtained. If such a situation is found, set the Drive Limit control fully counterclockwise (minimum drive limit).

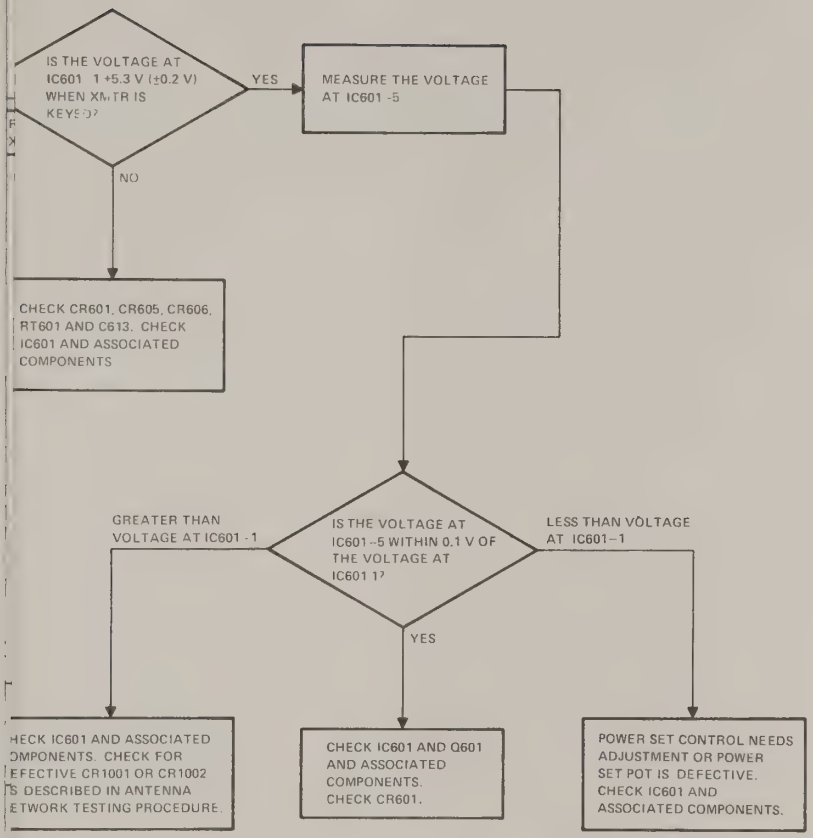
5.2.4 "No-Power" Protect Circuit Test

The "no-power" protect circuit prevents the transmitter power amplifier from being operated without being connected to the antenna network. If the forward power detector in the antenna network does not sense more than approximately 7 watts, the "no-power" protect circuit will shut-off the drive to the power amplifier stages. This protect circuit can be made to operate to check its performance by turning the power output of the transmitter down below 7 watts using the POWER SET control. Once the "no-power" protect circuit operates, the transmitter must be re-keyed to return drive power after the original "no-power" condition is corrected.

5.3 TROUBLESHOOTING

5.3.1 The power control board troubleshooting chart outlines a logical procedure for finding major functional failures. However, because of the complexity of the circuit operation, it is impossible to provide a troubleshooting chart that will be usable for some of the more subtle problems that may appear in the power control board performance tests. Efficient location of these "subtle" problems depends on a thorough knowledge of the power control board theory of operation. In any case, it is a good idea to review the power control board theory on the schematic diagram before beginning troubleshooting.

5.3.2 Once you are familiar with the circuit operation, a defective stage or component can be found by making voltage measurements and comparing them with those shown on the schematic diagram. Observe the voltage


IS THE VOLTAGE AT IC601 1 +5.3 V (±0.2 V) WHEN XMTR IS KEYED?
YES
MEASURE THE VOLTAGE AT IC601 -5
NO
CHECK CR601, CR605, CR606, RT601 AND C613. CHECK IC601 AND ASSOCIATED COMPONENTS
GREATER THAN VOLTAGE AT IC601 -1
IS THE VOLTAGE AT IC601-5 WITHIN 0.1 V OF THE VOLTAGE AT IC601 1?
LESS THAN VOLTAGE AT IC601-1
YES
HECK IC601 AND ASSOCIATED OMPONENTS. CHECK FOR EFECTIVE CR1001 OR CR1002 S DESCRIBED IN ANTENNA ETWORK TESTING PROCEDURE.
CHECK IC601 AND Q601 AND ASSOCIATED COMPONENTS. CHECK CR601.
POWER SET CONTROL NEEDS ADJUSTMENT OR POWER SET POT IS DEFECTIVE. CHECK IC601 AND ASSOCIATED COMPONENTS.

ROL BOARD
EADINGS

CIRCUIT METERED	READING
FORWARD POWER	SEE CALIBRATION LABEL
REFLECTED POWER	MAXIMUM READINGS (WITH NORMAL REFLECTED POWER) 12–15 uA (B/C34) 14–17 uA (B/C44) 16–19 uA (B/C54) 18–22 uA (B/C64)
CONTROL VOLTAGE	RANGE 30/25 uA NOTE 1
12 W PA CURRENT (USED IN 12 W STATIONS ONLY)	25/27 uA NOTE 1

READING IS FOR THE
z BAND AND THE SECOND
420 AND 470–512 MHz BAND.

TROUBLESHOOTING PREREQUISITES

1. CONNECT THE RADIO ANTENNA CONNECTOR TO AN RF WATTMETER THAT IS TERMINATED IN A 50–OHM RESISTIVE DUMMY LOAD. BE SURE THE WATTMETER AND DUMMY LOAD ARE RATED FOR UHF USE.
2. THE POWER CONTROL BOARD MUST BE INSTALLED IN A COMPLETE RADIO FOR TESTING. TO PROVIDE THE NECESSARY POWER, GROUND, AND CONTROL CONNECTIONS. BE SURE THE CIRCUIT BOARD MOUNTING SCREWS ARE SECURE AND THAT ALL CONNECTIONS TO THE CIRCUIT BOARD ARE PROPERLY MADE.
3. USING A TEK–37 ADAPTER CABLE, CONNECT A MOTOROLA PORTABLE TEST SET TO THE RADIO AS FOLLOWS:
   A. CONNECT THE 20–PIN CONNECTOR OF THE ADAPTER CABLE TO THE RECEPTACLE ON THE FRONT OF THE TEST SET.
   B. CONNECT THE ADAPTER CABLE RED "CONTROL" PLUG TO THE RECEPTACLE ON THE CONTROL (INTERCONNECT) BOARD.
   C. CONNECT THE ADAPTER CABLE WHITE "METERING" PLUG AS NEEDED IN THE TROUBLESHOOTING PROCEDURE.
4. SET THE TEST SET SWITCHES AS FOLLOWS:
   A. SET THE TEST SET FUNCTION SWITCH TO THE XMTR POSITION.
   B. SET THE TEST SET METER SWITCH TO THE OFF POSITION.
   C. SET THE TEST SET METER SELECTOR SWITCH AS REQUIRED BY THE TROUBLESHOOTING PROCEDURE.
   D. SET THE ADAPTER CABLE REF SWITCH AS REQUIRED BY THE TROUBLESHOOTING PROCEDURE.
   E. SET THE ADAPTER CABLE 1 V–100 mV SWITCH TO THE 100 mV POSITION. IF THE ADAPTER CABLE HAS NO SUCH SWITCH THE UNIT OPERATES AT 100 mV AT ALL TIMES.
5. USING BUILT–IN STATION METERING, CONNECT THE "CONTROL" PLUG TO THE CONTROL RECEPTACLE (J3) ON THE UNIFIED CHASSIS INTER–CONNECT BOARD. ALSO, CONNECT THE METERING PLUG AS NEEDED IN THE TROUBLESHOOTING CHART.

Power Control Board Troubleshooting Chart
Motorola No. EEPS-17433-A
1/5/76-UP

Refer to the Power Amplifier Power Set Procedure in the Transmitter Alignment Section of this manual.

Step 1. Key the transmitter.

Step 2. Adjust the POWER SET control until the rated power output is reached.

Step 3. Unkey the transmitter.

5.2.2 Automatic Power Leveling Test

A separate variable voltage dc power supply must be used to perform this test.

Step 1. Disconnect the 13.6 volt lead at the PA. Connect a 16 volt source to the PA in its place. Set the power supply output to +13.6 volts.

Step 2. Key the transmitter.

Step 3. Vary the supply voltage from +13.6 volts to +16 volts. The transmitter output change should be between +10% and -5%.

Step 4. Unkey the transmitter and reconnect the PA to the station's power supply.

5.2.3 Drive Limit Control

5.2.3.1 This control allows the drive power to the power amplifier from the controlled stage to be limited to a level sufficient to provide rated performance. Its purpose is to set a limit on the drive power that can be called for by the automatic power leveling circuitry. This prevents earlier PA stages from being damaged by overdrive if later stages fail. Depending on the position of the Drive Limit control, the maximum collector voltage of the controlled stage can be limited to between 6.5 volts and 12.5 volts. The proper procedure for setting the Drive Limit control is given in the Transmitter Alignment Procedure under the Power Amplifier Power Setting Section.

CAUTION

For proper operation of the power leveling circuitry, the Drive Limit control must not be set for any lower power output than that given in the Drive Limit column in Table 1 of the Power Setting Section.

5.2.3.2 In stations with high gain driver and power amplifier stages, the power leveling power set circuitry may operate the controlled stage at a collector voltage less than 6.5 volts. In such stations, little or no effect will be seen from the Drive Limit control. If it is not possible to lower power output by the Drive Limit control to the level called for in the alignment procedure, set the Drive Limit control to its maximum clockwise position (maximum drive limit).

5.2.3.3 In some stations the rf drive reserve is not sufficient to require use of the Drive Limit control. In these stations power output level called for in the power control board alignment procedure cannot be obtaine If such a situation is found, set the Drive Limit control fully counterclockwise (minimum drive limit).

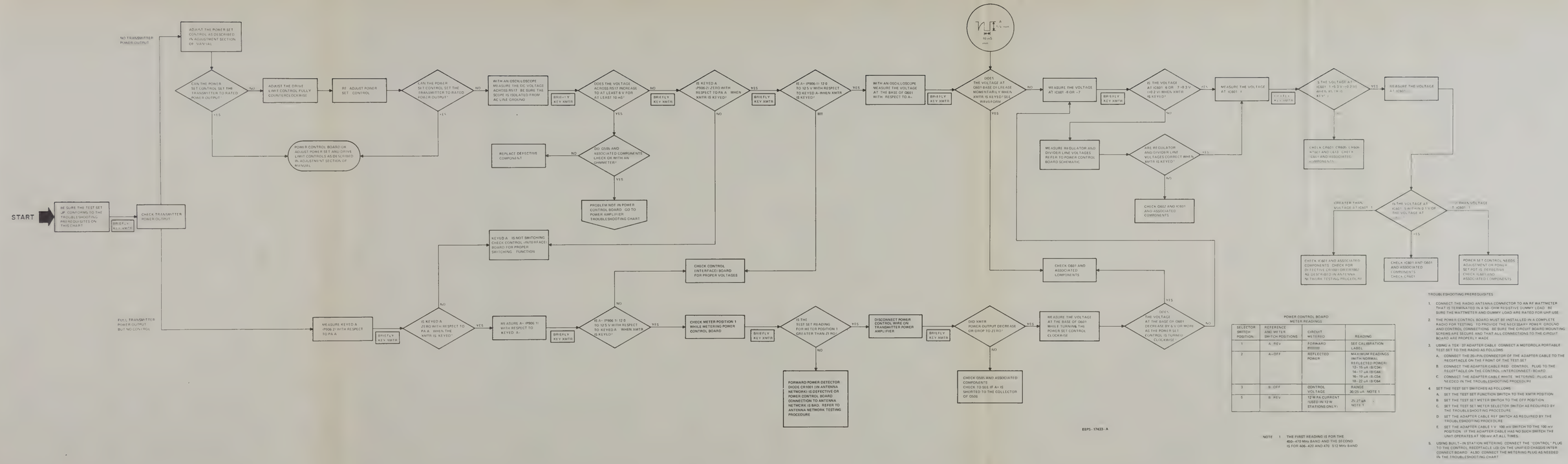
5.2.4 "No-Power" Protect Circuit Test

The "no-power" protect circuit prevents the transmitter power amplifier from being operated without being connected to the antenna network. If the forward power detector in the antenna network does not sense more than approximately 7 watts, the "no-power" protect circuit will shut-off the drive to the power amplifier stages. This protect circuit can be made to operate to check its performance by turning the power output of the transmitter down below 7 watts using the POWER SET control. Once the "no-power" protect circuit operates, the transmitter must be re-keyed to return drive power after the original "no-power" condition is corrected.

5.3 TROUBLESHOOTING

5.3.1 The power control board troubleshooting chart outlines a logical procedure for finding major functional failures. However, because of the complexity of the circuit operation, it is impossible to provide a troubleshootir chart that will be usable for some of the more subtle problems that may appear in the power control board performance tests. Efficient location of these "subtle" problems depends on a thorough knowledge of the power control board theory of operation. In any case, it is a good idea to review the power control board theory on the schematic diagram before beginning troubleshooting.

5.3.2 Once you are familiar with the circuit operation, a defective stage or component can be found by making voltage measurements and comparing them with those shown on the schematic diagram. Observe the voltage


START
BE SURE THE TEST SET UP CONFORMS TO THE TROUBLESHOOTING PREREQUISITES ON THIS CHART
BRIEFLY KEY XMTR
CHECK TRANSMITTER POWER OUTPUT
NO TRANSMITTER POWER OUTPUT
ADJUST THE POWER SET CONTROL AS DESCRIBED IN ADJUSTMENT SECTION OF MANUAL
CAN THE POWER SET CONTROL SET THE TRANSMITTER TO RATED POWER OUTPUT?
NO
YES
ADJUST THE DRIVE LIMIT CONTROL FULLY COUNTERCLOCKWISE
RF ADJUST POWER SET CONTROL
CAN THE POWER SET CONTROL SET THE TRANSMITTER TO RATED POWER OUTPUT?
NO
YES
POWER CONTROL BOARD OK ADJUST POWER SET AND DRIVE LIMIT CONTROLS AS DESCRIBED IN ADJUSTMENT SECTION OF MANUAL
WITH AN OSCILLOSCOPE MEASURE THE DC VOLTAGE ACROSS R517. BE SURE THE SCOPE IS ISOLATED FROM AC LINE GROUND
BRIEFLY KEY XMTR
DOES THE VOLTAGE ACROSS R517 INCREASE TO AT LEAST 6 V FOR AT LEAST 10 mS?
NO
YES
REPLACE DEFECTIVE COMPONENT
NO
DO Q505 AND ASSOCIATED COMPONENTS CHECK OK WITH AN OHMMETER?
YES
PROBLEM NOT IN POWER CONTROL BOARD. GO TO POWER AMPLIFIER TROUBLESHOOTING CHART
BRIEFLY KEY XMTR
IS KEYED A (P906-2) ZERO WITH RESPECT TO PA A WHEN XMTR IS KEYED?
YES
NO
BRIEFLY KEY XMTR
IS A+ (P906-1) 12 0 TO 12 5 V WITH RESPECT TO A- WHEN XMTR IS KEYED?
YES
BII
WITH AN OSCILLOSCOPE MEASURE THE VOLTAGE AT THE BASE OF Q601 WITH RESPECT TO A-
BRIEFLY KEY XMTR
DOES THE VOLTAGE AT Q601 BASE DIP LIKE ASE MOMENTARILY WHEN XMTR IS KEYED? SEE WAVEFORM
NO
YES
MEASURE THE VOLTAGE AT IC601-8 OR -7
BRIEFLY KEY XMTR
IS THE VOLTAGE AT IC601-8 OR -7 9 3 V (+0 2 V) WHEN XMTR IS KEYED?
YES
NO
MEASURE REGULATOR AND DIVIDER LINE VOLTAGES REFER TO POWER CONTROL BOARD SCHEMATIC
ARE REGULATOR AND DIVISION LINE VOLTAGES CORRECT WHEN XMTR IS KEYED?
YES
NO
CHECK Q602 AND IC601 AND ASSOCIATED COMPONENTS
MEASURE THE VOLTAGE AT IC601-1
BRIEFLY KEY XMTR
IS THE VOLTAGE AT IC601-1 +5 3 V (+0 2 V) WHEN XMTR IS KEYED?
YES
CHECK CR601 CR605 L505 AT Q601 AND Q602 CHECK Q601 AND ASSOCIATED COMPONENTS
MEASURE THE VOLTAGE AT IC601-1
IS THE VOLTAGE AT IC601-1 WITHIN 0 1 V OF THE VOLTAGE AT IC601-7?
YES
CHECK IC601 AND Q601 AND ASSOCIATED COMPONENTS CHECK CR601
NO
GREATER THAN VOLTAGE AT IC601-7
CHECK IC601 AND ASSOCIATED COMPONENTS CHECK FOR DEFECTIVE CR1001 OR R1002 AS DESCRIBED IN ANTENNA NETWORK TESTING PROCEDURE
LESS THAN VOLTAGE AT IC601-7
POWER MET CONTROL NEEDS ADJUSTMENT OR POWER SET-POT IS DEFECTIVE CHECK Q601 AND ASSOCIATED COMPONENTS
KEYED A IS NOT SWITCHING CHECK CONTROL INTERFACE BOARD FOR PROPER SWITCHING FUNCTION
CHECK CONTROL (INTERFACE) BOARD FOR PROPER VOLTAGES
CHECK Q601 AND ASSOCIATED COMPONENTS
FULL TRANSMITTER POWER OUTPUT BUT NO CONTROL
MEASURE KEYED A (P906-2) WITH RESPECT TO PA A
BRIEFLY KEY XMTR
IS KEYED A ZERO WITH RESPECT TO PA A WHEN THE XMTR IS KEYED?
NO
YES
MEASURE A+ (P906-1) WITH RESPECT TO KEYED A-
BRIEFLY KEY XMTR
IS A+ (P906-1) 12 0 TO 12 5 V WITH RESPECT TO KEYED A WHEN XMTR IS KEYED?
NO
YES
CHECK METER POSITION 1 WHILE METERING POWER CONTROL BOARD
BRIEFLY KEY XMTR
IS THE TEST SET READING FOR METER POSITION 1 GREATER THAN ZERO?
YES
NO
FORWARD POWER DETECTOR DIODE CR1001 (IN ANTENNA NETWORK) IS DEFECTIVE OR POWER CONTROL BOARD CONNECTION TO ANTENNA NETWORK IS BAD. REFER TO ANTENNA NETWORK TESTING PROCEDURE
DISCONNECT POWER CONTROL WIRE ON TRANSMITTER POWER AMPLIFIER
BRIEFLY KEY XMTR
DID XMTR POWER OUTPUT DECREASE OR DROP TO ZERO?
YES
NO
CHECK Q505 AND ASSOCIATED COMPONENTS CHECK TO SEE IF A+ IS SHORTED TO THE COLLECTOR OF Q505
MEASURE THE VOLTAGE AT THE BASE OF Q601 WHILE TURNING THE POWER SET CONTROL CLOCKWISE
DOES THE VOLTAGE AT THE BASE OF Q601 DECREASE BY 5 V OR MORE AS THE POWER SET FUNCTION IS TURNED CLOCKWISE?
YES
NO
EEPS-17433-A

POWER CONTROL BOARD METER READINGS

SELECTOR SWITCH POSITION	REFERENCE AND METER SWITCH POSITIONS	CIRCUIT METERED	READING
1	A -REV	FORWARD POWER	SEE CALIBRATION LABEL
2	A—OFF	REFLECTED POWER	MAXIMUM READINGS (WITH NORMAL REFLECTED POWER): 12—15 uA (B/C34) 14—17 uA (B/C64) 16—19 uA (B/C54) 18—22 uA (B/C64
3	B -OFF	CONTROL VOLTAGE	RANGE: 30-29 vA NOTE 1
5	B -REV	12 W PA CURRENT USED IN 12 W STATIONS ONLY:	25-27 uA NOTE 1

NOTE 1 THE FIRST READING IS FOR THE 450—470 MHz BAND AND THE SECOND IS FOR 406—420 AND 470 512 MHz BAND

TROUBLESHOOTING PREREQUISITES

1. CONNECT THE RADIO ANTENNA CONNECTOR TO AN RF WATTMETER THAT IS TERMINATED IN A 50-OHM RESISTIVE DUMMY LOAD BE SURE THE WATTMETER AND DUMMY LOAD ARE RATED FOR UHF USE
2. THE POWER CONTROL BOARD MUST BE INSTALLED IN A COMPLETE RADIO FOR TESTING TO PROVIDE THE NECESSARY POWER GROUND AND CONTROL CONNECTIONS BE SURE THE CIRCUIT BOARD MOUNTING SCREWS ARE SECURE AND THAT ALL CONNECTIONS TO THE CIRCUIT BOARD ARE PROPERLY MADE
3. USING A TEK-37 ADAPTER CABLE CONNECT A MOTOROLA PORTABLE TEST SET TO THE RADIO AS FOLLOWS
   - A. CONNECT THE 26-PIN CONNECTOR OF THE ADAPTER CABLE TO THE RECEPTACLE ON THE FRONT OF THE TEST SET
   - B. CONNECT THE ADAPTER CABLE RED CONTROL PLUG TO THE RECEPTACLE ON THE CONTROL (INTER)CONNECT BOARD
   - C. CONNECT THE ADAPTER CABLE WHITE METERING PLUG AS NEEDED IN THE TROUBLESHOOTING PROCEDURE
4. SET THE TEST SET SWITCHES AS FOLLOWS
   - A. SET THE TEST SET FUNCTION SWITCH TO THE XMTR POSITION
   - B. SET THE TEST SET METER SWITCH TO THE OFF POSITION
   - C. SET THE TEST SET METER SELECTOR SWITCH AS REQUIRED BY THE TROUBLESHOOTING PROCEDURE
   - D. SET THE ADAPTER CABLE REF SWITCH AS REQUIRED BY THE TROUBLESHOOTING PROCEDURE
   - E. SET THE ADAPTER CABLE 1 V - 100 mV SWITCH TO THE 100 mV POSITION IF THE ADAPTER CABLE HAS NO SUCH SWITCH THE UNIT OPERATES AT 100 mV AT ALL TIMES.
5. USING BUILT-IN STATION METERING CONNECT THE "CONTROL" PLUG TO THE CONTROL RECEPTACLE J(3) ON THE UNIFIED CHASSIS/INTER CONNECT BOARD ALSO CONNECT THE METERING PLUG AS NEEDED IN THE TROUBLESHOOTING CHART

PWR CONT BOARD TROUBLESHOOTING CHART

Power Control Board Troubleshooting Chart
Motorola No. EEPS-17433-A
1/5/76-UP

changes that occur when the POWER SET and Drive Limit controls are varied.

5.3.3 The transmitter power amplifier stages can be disabled to permit easier power control board troubleshooting. To disable the PA stages, remove the heavy RED lead from the barrier strip and cover with an insulator. On 12 watt units, remove the interconnect plug. If the PA stages are disabled, the "No-Power" protect circuits will go into operation. To disable the "No-Power" protect circuits, use the following procedure.

Step 1. Remove ac input power from the station.

Step 2. Remove the shield from the power control board.

Step 3. Connect a jumper across C611 on the power control board.

Step 4. Reconnect ac power to the station and perform whatever troubleshooting is required.

CAUTION

Before the power amplifier stages are re-enabled, be sure you re-enable the "No-Power" protect circuit. DO NOT OPERATE THE POWER AMPLIFIER STAGES WITH THE "NO-POWER" PROTECT CIRCUITS DISABLED.

5.3.4 The following table lists some power control board malfunctions and their possible causes:

Power Control Board Troubleshooting Hints

Symptom	Possible Cause - Check the following:
Power Set malfunctioning	a. Power detector diodes CR1001 and/or CR1002
	b. IC601 bias circuitry
	c. POWER SET pot
Drive Limit malfunctioning	a. CR603
	b. Drive Limit pot
"No-Power" protect malfunctioning	a. CR604
	b. C611

6. ANTENNA NETWORK

NOTE

Field servicing of the antenna network is not recommended. If an antenna network is defective, it must be replaced as a unit.

6.1 PERFORMANCE TESTS

6.1.1 Transmitter Leg Insertion Loss Measurement (Repeater & Base Stations)

The transmitter leg insertion loss should be about 0.8 to 0.9 dB (15-20% power loss). Use the following procedure:

Step 1. Connect a thru-line wattmeter, a 50-ohm dummy load, and adapter cables as shown in Figure 18.

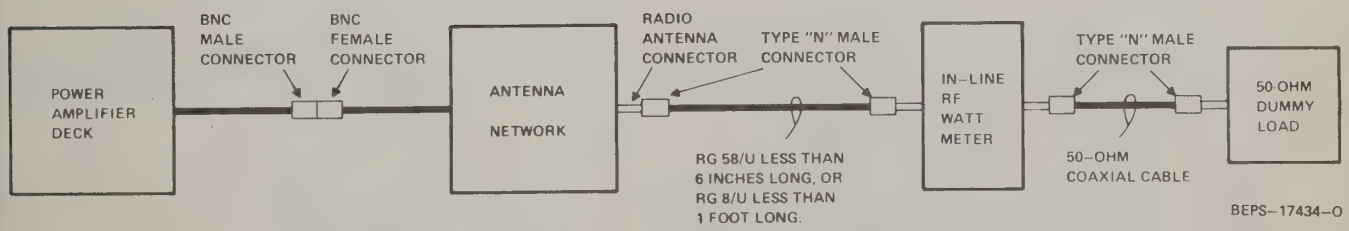

POWER AMPLIFIER DECK
BNC MALE CONNECTOR
BNC FEMALE CONNECTOR
ANTENNA NETWORK
RADIO ANTENNA CONNECTOR
TYPE "N" MALE CONNECTOR
IN-LINE RF WATT METER
TYPE "N" MALE CONNECTOR
50-OHM DUMMY LOAD
RG 58/U LESS THAN 6 INCHES LONG, OR RG 8/U LESS THAN 1 FOOT LONG.
50-OHM COAXIAL CABLE
BEPS-17434-O

Figure 18.

Transmitter Leg Insertion Loss Test Set-Up

NOTE

For accurate wattmeter readings, make sure low VSWR cable connections are made at all points. This means that all connectors must be properly installed and that a minimum number of adapters are used.

Step 2. Key the transmitter and write down the wattmeter reading.

Step 3. Insert the rf wattmeter between the power amplifier and the antenna network. Place an N through connector in place of the wattmeter between the antenna network and the dummy load.

Step 4. Key the transmitter and take a second wattmeter reading.

Step 5. If the difference between the two wattmeter readings is greater than 20% of the second wattmeter reading, replace the antenna network. Refer to the antenna network removal and reinstallation procedure in paragraph 6.2.

6.1.2 Receiver Leg Insertion Loss Measurement (Base Stations Only)

The antenna network receiver leg insertion loss should be about 1.2 to 1.3 dB (a voltage loss of 10-15%). Use the following procedure to measure the receiver leg insertion loss:

Step 1. Connect a rf signal generator to the antenna network output connector (P1012) through a 6 dB rf pad.

Step 2. Make a 20 dB quieting sensitivity measurement. Refer to the receiver rf and i-f troubleshooting chart for the test procedure. Write down the measured 20 dB quieting sensitivity.

Step 3. Connect the rf signal generator to the rf input of the receiver rf and i-f board (J104) at the bottom of the unified chassis.

Step 4. Make a second 20 dB quieting sensitivity check. Write down this second 20 dB quieting sensitivity figure.

Step 5. If the difference between the two 20 dB quieting sensitivity figures is greater than 15% of the second 20 dB quieting sensitivity figure, replace the antenna network. Refer to the antenna network removal and reinstallation procedure in paragraph 6.2.

6.1.3 Antenna/PA Isolation Measurement (Repeater & Base Stations)

The antenna network ensures that, should the antenna load open, the transmitter output power reflected back to the PA will be reduced by at least 20 dB. Lack of sufficient reflected power attenuation can damage the power amplifier.

Step 1. Disconnect the 7.5 ampere in-line high current A+ fuse between the power amplifier and unified chassis to prevent transmitter PA operation.

Step 2. Disconnect the transmitter output coax cable from the ANT NETWORK IN receptacle (P1011) on the antenna network.

Step 3. Disconnect the antenna network output cable from output receptacle P1012 on the antenna network.

Step 4. Connect an rf signal generator to the output receptacle, P1012, and an rf voltmeter to the ANT NETWORK IN receptacle, P1011.

Step 5. Set the signal generator to the transmitter frequency and at maximum output level.

Step 6. Note the rf voltmeter reading. The reading should be at least 90% lower than the signal generator output level (20 dB).

Step 7. If the isolation isn't at least 17 dB, replace the antenna network. See the removal and reinstallation procedure in paragraph 6.2.

Step 8. Repeater stations -- proceed to following step 9. Base stations -- proceed to following paragraph 6.1.4.

Step 9. Disconnect the test equipment and reconnect all previously removed station cables. Be sure also to reconnect the fuse that was removed in step 1.

6.1.4 Transmitter Output/Receiver Input Isolation Measurement (Base Stations Only)

The antenna network provides approximately 20 dB of isolation between the transmitter rf output connector and the receiver output cable with the transmitter unkeyed and the station's antenna connector terminated in a 50-ohm load. When the transmitter is keyed, switching action

in the receiver leg of the network provides 40-50 dB of additional isolation. Perform the following procedure to ensure that proper switching action takes place.

NOTE

Lack of switching action in the receiver leg of the network can allow sufficient transmitter power into the receiver to damage the receiver mixer transistor.

Step 1. Be sure that the 7.5 ampere in-line high current A+ fuse between the power supply and unified chassis is disconnected to prevent transmitter PA operation.

Step 2. Disconnect the transmitter output coaxial cable from the ANT NETWORK IN receptacle (P1011) on the antenna network.

Step 3. Connect an rf signal generator to the antenna receptacle (P1012) and an rf voltmeter to the receiver output receptacle (P1013) of the network. (If a voltmeter is not available, leave the cable connected to the receiver rf deck and use 20 dB quieting as a measuring reference.)

Step 4. Set the signal generator to the receiver frequency and at maximum output level. With the transmitter unkeyed, the presence of the injected signal from the signal generator should be noted on the rf voltmeter with only slight attenuation (1.2 to 1.3 dB).

Step 5. Make sure the transmitter is disconnected from the network. Key the transmitter and check the rf voltmeter reading.

Step 6. The rf voltmeter reading should drop at least 60 dB (a voltage reduction of 1000 times). If receiver 20 dB quieting is used as a reference, signal generator level should have to be 1000 times greater than normal 20 dB quieting or approximately 500 microvolts.

Step 7. If the isolation is less than 60 dB, replace the antenna network. See the removal and reinstallation procedure in paragraph 6.2.

Step 8. Disconnect the test equipment. Reconnect the transmitter output cable to the antenna network. Reconnect fuse F1 that was removed in step 1.

6.2 ANTENNA NETWORK REMOVAL AND REINSTALLATION PROCEDURE

NOTE

Steps 1 and 2 are performed from the front of the station.

Step 1. All models except 12-watt models:

Step 1a. Disconnect the LOW LEVEL AMP OUT and ANT NETWORK IN connectors from the unified chassis.

Step 1b. Loosen the three captivated shield cover screws and remove the cover.

Step 1c. Loosen the captivated screw that holds the ANT NETWORK IN receptacle bracket and remove the receptacle from its mounting bracket.

Step 2. 12-watt models only:

Step 2a. Loosen the two captivated power amplifier assembly screws on the PA heat sink.

Step 2b. Pivot and lift the PA assembly up and off the pivot bushing and simultaneously disconnect the following connectors:

-- power plug from 12 W PA receptacle (J1001) on transmitter interconnect board.

-- tripler plug from low-level amplifier output receptacle on tripler/low-level amplifier.

-- PA output plug from antenna network.

The PA assembly is now completely disconnected from the unified chassis and can be placed to one side while antenna network removal is completed.

NOTE

The following steps are performed from the rear of the station.

Step 3. Base stations only -- Disconnect the receiver output coaxial cable from the antenna network heat sink.

Step 4. Disconnect the antenna output coaxial cable from the antenna network heat sink.

Step 5. Loosen the two captivated antenna network mounting screws (on heat sink).

Step 6. Carefully slide the antenna network out of the unified chassis.

Step 7. To reinstall the antenna network, reverse the procedure given in steps 1-6.

TRANSMITTER INTERCONNECT BOARD

MODEL TLN5645A (RPTR)

MODEL TLN5647A (BASE)

MODEL TRN6195A (FULL FILTERING OPTION)

FUNCTIONS -

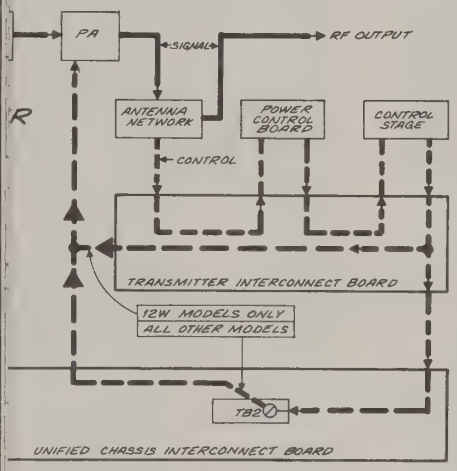
--Interconnects most transmitter circuit boards to each other (except PA).

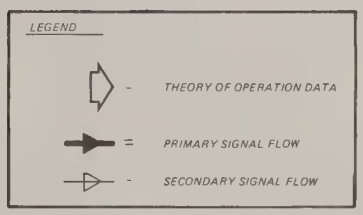
--Routes control functions from the unified chassis interconnect board to the transmitter.

--Repeater version includes unique transmitter filtering components.

--Includes partial control stage circuitry used to govern PA power output.

--Includes current limiter stage (base stations only) which is electrically functional with antenna network.





REFERENCE SYMBOL

PARTS LI

TRANSMITTER
TRN6195A (full
TRN6195A (rep
TLN5647A (bas

C1 thru 18

C19
C20 thru 43

C44 thru 50
C901, 902, 903, 904
C905, 906, 908, 910
C907
C909
C911, 912
C913, 914
C915, 916
C917, 918, C919, 920

CR901, 902
CR903

J1000, 1004
J1001
J1002
J1003

L1, 2, 3, 4, 5, 6, 13, 14, 16, 19, 20, 22, 25
L7, 8, 9, 10, 11, 12, 15, 17, 18, 21, 23, 24, 905, 906, 907, 909
L901, 902, 903, 904
L908
L910, 911

Q901

R901
R902, 903, 904, 905
R906, 907, 911
R908
R909
R910

ED
PICOFARADS.
E USED ONLY
N5645A MODELS.
ALL FILTERING
1–L25). THE
FILTERING
ICATED ON
ND PARTS
MODEL DOES
ERING
ATES "THRU"
RUNS AND
NOT EXIST

ASS CAPACITORS
GROUND RUNS
FROM BEING CON–
ASSIS INTERCONNECT
TION OPERATION.
L911 (FUNCTIONAL
LY) PROVIDE
ATION METERING.

C919 SHUNT RF
)– AND POWER

KES L902–L904
OT USED ON

NOTES:

1. Replacer
Motorola

2. The follo
Capacito
44, 902,
902, 903

3. The follo
Capacito

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

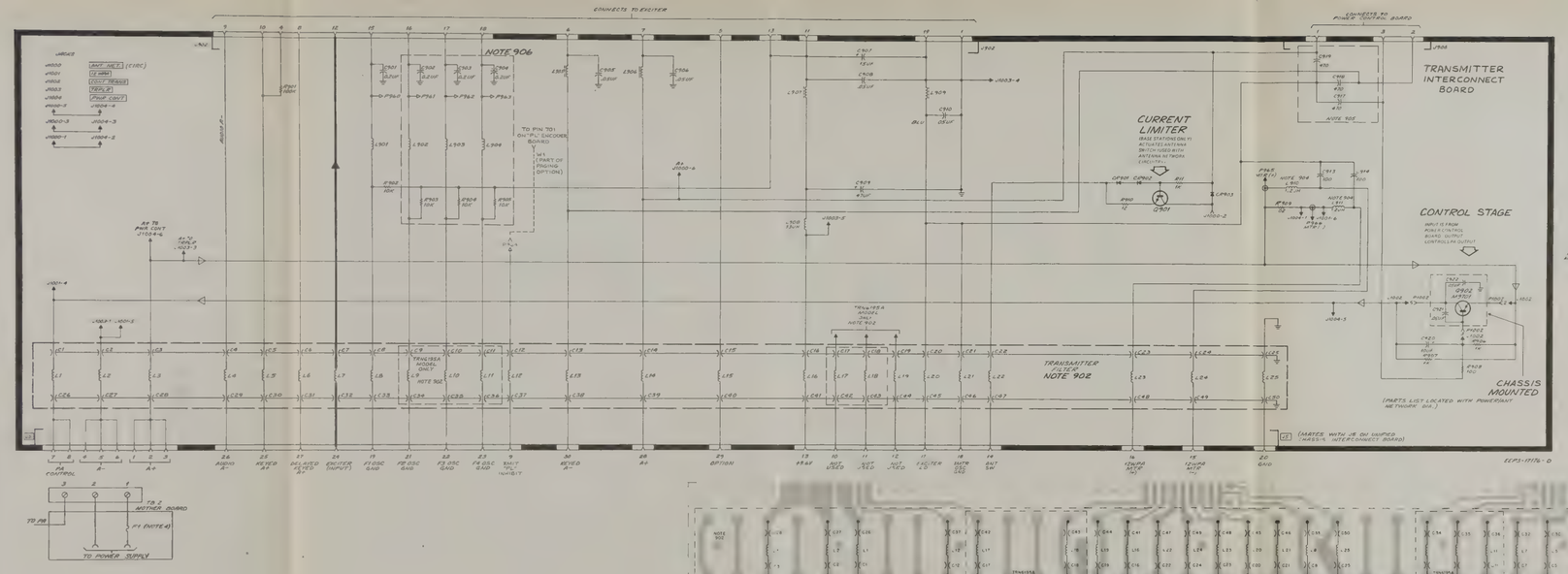
TRANSMITTER INTERCONNECT BOARD
TRN6195A (full filtering option)
TRN6195A (repeater standard)
TLN5647A (base station) PL-3407-C

		CAPACITOR: fixed:
C1 thru 18	21-861219	1000 pF +100-0%; 500 V (SEE NOTES 2, 3)
C19	21-828129M01	100 pF ±10%; 500 V
C20 thru 43	21-861219	1000 pF +100-0%; 500 V (SEE NOTES 2, 3)
C44 thru 50	21-828129M01	100 pF ±10%; 500 V
C901, 902, 903, 904	21-82372C02	0.2 uF +80-20%; 25 V (NOTE 2)
C905, 906, 908, 910	21-82372C04	0.05 uF +80-20%; 25 V
C907	23-83214C02	15 pF ±20%; 20 V
C909	23-82783B31	47 pF ±20%; 20 V
C911, 912		NOT USED
C913, 914	21-82E04B06	100 pF ±10%; N1500
C915, 916		NOT USED
C917, 918, C919, 920	21-82187B07 23-83214C20	470 pF ±10%; 500 V 10 pF ±20%; 20 V
		DIODE: (NOTE 1)
CR901, 902	48-82392B12	silicon
CR903	48-824e6H13	silicon
		CONNECTOR, receptacle:
J1000, 1004	28-83461P01	male, 6 pin, white
J1001	28-83441P06	male, 6 pin, red
J1002	28-83441P04	male, 5 pin, red
J1003	28-83461P05	male, 5 pin, white
		COIL, rf:
L1, 2, 3, 4, 5, 6, 13, 14, 15, 19, 20, 22, 25	24-83977B01	1-1/2 turns (NOTE 3)
L7, 8, 9, 10, 11, 12, 16, 17, 18, 21, 23, 24, 905, 906, 907, 909	24-83961B01	3 turns (NOTES 2, 3)
L901, 902, 903, 904	24-80909A61	choke 0.62 uH (NOTE 2)
L908	24-854314	choke 33 uH
L910, 911	24-82723H01	choke 1.2 uH
		TRANSISTOR: (SEE NOTE 1)
Q901	48-869640	type M9640
		RESISTOR, fixed: ±10%; 1/4 W unless otherwise stated
R901	6-124C97	100k
R902, 903, 904, 905	6-124C73	10k (NOTE 2)
R906, 907, 911	6-124C49	1k
R908	17-82291B21	100 ±5%; 3 W
R909	17-82620B03	0.02 ±5%; 3 W
R910	6-124A03	12 ±5%

NON-REFERENCED ITEMS		
	3-134169	SCREW, tapping: 4-40 x 1/4" "Phillips", hex head
	3-139495	SCREW, tapping: 4-40 x 5/16" "Phillips
	5-84220B01	GROMMET
	14-83375K01	INSULATOR
	42-83629G01	FASTENER, driver
	1-80775B71	FILTER BRACKET ASSY.
	1-80775B75	FILTER BRACKET COVER

NOTES:

1. Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.
2. The following items are not used with Model TLN5645A: Capacitors C9, 10, 11, 17, 18, 19, 34, 35, 36, 42, 43, 44, 902, 903, and 904; Coils L9, 10, 11, 23, 24, 25, 902, 903, and 904; Resistors R903, 904, and 905.
3. The following items are not used with Model TLN5647: Capacitors C1-50; Coils L1-25.



TRANSMITTER INTERCONNECT BOARD

MODEL TLN5645A (RPTR)
MODEL TLN5647A (BASE)
MODEL TRN6195A (FULL FILTERING OPTION)

FUNCTIONS -

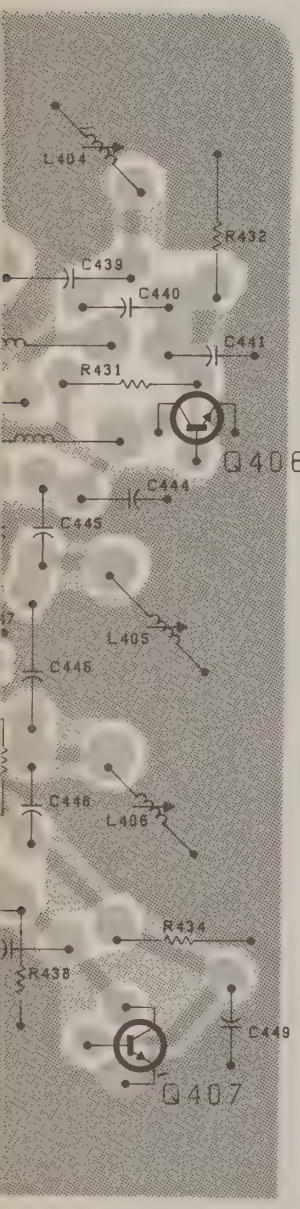
--Interconnects most transmitter circuit boards to each other (except PA).

--Routes control functions from the unified chassis interconnect board to the transmitter.

--Repeater version includes unique transmitter filtering components.

--Includes partial control stage circuitry used to govern PA power output.

--Includes current limiter stage (base stations only) which is electrically functional with antenna network.



P402
RF
OUTPUT

SOLDER SIDE BD-DEPS-16779-0
COMPONENT SIDE BD-DEPS-16780-0
OL-DEPS-18717-0

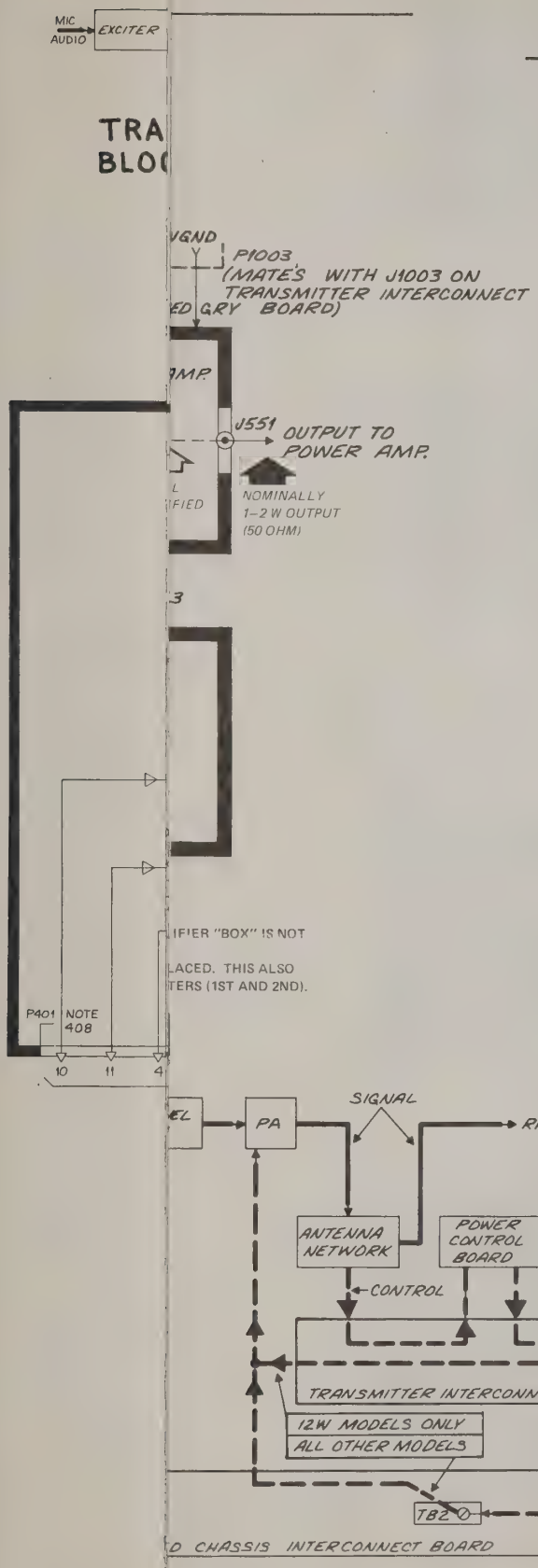
ASSEMBLY

EXCITER/1ST BANDPASS FILTER
TLE1720A SERIES
TRIPLER/LOW LEVEL AMP

FUNCTION -

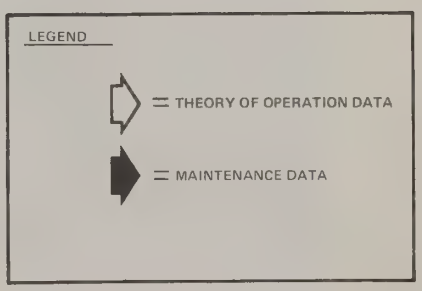
Exciter -- Produces modulated RF signal in 135-171 MHz range.

1st Bandpass Filter -- Attenuates signals outside the bandpass range.



MODEL TABLE

TRIPLER/LOW LEVEL AMPLIFIER ASSEMBLY	TLN5650A CHASSIS AND HARDWARE KIT	TRIPLER/ LOW LEVEL AMPL				2ND BAND PASS FILTER			
		TLE8391A	TLE8393A	TLE8394A	TLE8395A	TFE6151A	TFE6153A	TFE6154A	TFE6155A
TLE1601A (406–420 MHz)	X	X				X			
TLE1603A (450–470 MHz)	X		X				X		
TLE1604A (470 494 MHz)	X			X				X	
TLE1605A (494–512 MHz)	X				X				X



PEPS-18716-B
(Sheet 2 of 2)
1/4/77-UP

EXCITER/1ST BANDPASS FILTER
TLE1721B & TLE1723A SERIES
TRIPLER/LOW LEVEL AMPLIFIER
TLE1600A SERIES

PARTS LIST

LEGEND
L = 132-150.8 MHz
H = 150.8-174 MHz

TLD5491A, AV Exciter (132-150.8 MHz)
TLD5492A, AV Exciter (150.8-174 MHz) PL-4122-B

This parts list covers two models of the high band Exciter Board. Where differences exist a letter suffix L or H is added to the reference symbol to show the applicable unit.

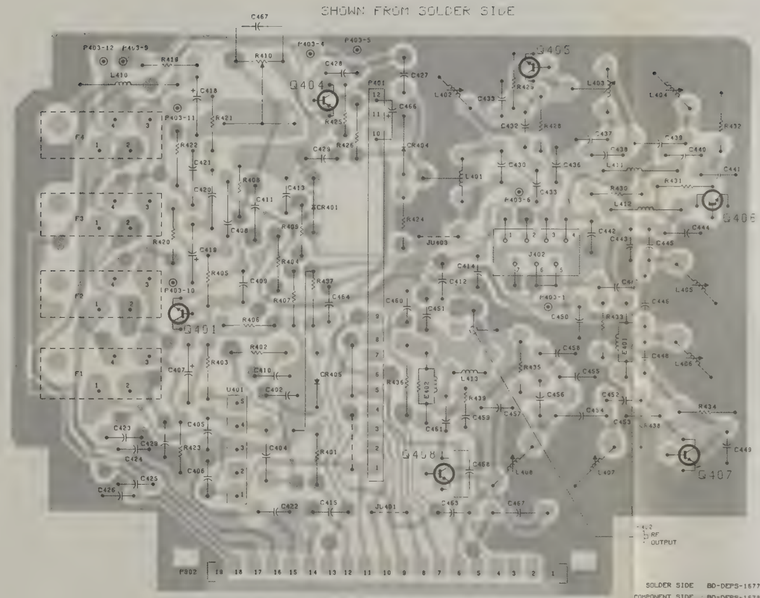
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: pF ±5%; 500 V unless otherwise stated
C401	21-831125	100 ±10%; 300 V
C402	21-82428B59	.01 uF +80-20%; 200 V
C403		NOT USED
C404	8-82905G11	.22 uF ±10%; 50 V
C405	21-83596E13	.001 uF ±10%; 100 V
C406	21-82428B59	.01 uF +80-20%; 200 V
C407, 408	23-847e2H08	3, 9 uF ±20%; 15 V
C409, 410	21-831125	100 ±10%; 300 V
C411	21-82372C03	0.1 uF +80-20%; 25 V
C412, 413	21-83596E10	220 ±20%
C414, 415	21-831125	100 ±10%; 300 V
C416, 417		NOT USED
C418 thru 421	23-847e2H08	3, 9 uF ±20%; 15 V
C422	21-82372C04	.05 uF +80-20%; 25 V
C423	21-83596E10	220 ±20%
C424, 425, 426	21-82372C04	.05 uF +80-20%; 25 V
C427	21-83406D51	3 ±0.25 pF
C428	21-82133G06	27; 500 V
C429	21-82428B59	.01 uF +80-20%; 200 V
C430L	21-84494D07	150
C430H	21-84494B06	120
C431	21-83406D54	4 ±0.25 pF
C432L	21-84494B16	330
C432H	21-84494B13	240
C433L	21-84494B13	240
C433H	21-84494B46	180 ±1%
C434, 435		NOT USED
C436	21-82428B59	.01 uF +80-20%; 200 V
C437	21-83596E13	.001 uF ±10%; 100 V
C438L	21-84494D01	91
C438H	21-84494B24	39
C439L	21-861451	1.5 ±10%
C439H	21-864518	1 ±10%
C440L	21-852322	62
C447H	21-83406D87	43
C441L	21-84494B10	130
C441H	21-84494B46	180 ±1%
C442, 443	21-82428B59	.01 uF +80-20%; 200 V
C444L	21-84493B27	51; 200 V
C444H	21-84494B24	39
C445L	21-83406D91	40
C445H	21-84494B30	34
C446	21-82450B06	0.75 ±10%
C447	21-83596E13	.001 uF ±10%; 100 V
C448L	21-83406D92	36
C448H	21-83406D56	24
C449L	21-84493B31	57; 200 V
C449H	21-84494B28	43
C450	21-83596E13	.001 uF ±10%; 100 V
C451	21-82428B59	.01 uF +80-20%; 200 V
C452L	21-83406D93	16
C452H	21-83406D90	11
C453L	21-83406D81	20
C453H	21-83406D55	18
C454	21-82450B06	0.75 ±10%
C455	21-83596E13	.001 uF ±10%; 100 V
C456L	21-83406D90	11
C456H	21-83406D70	8 ±0.5 pF
C457	21-83406D89	10 ±0.5 pF
C458	21-83596E13	.001 uF ±10%; 100 V
C459	21-840365	24; NP0
C460	21-83596E10	220 ±20%
C461L	21-84494B07	150
C461H	21-84494B06	120
C462, 463	21-83596E13	.001 uF ±10%; 100 V
C464	21-82355B62	1.0
C465	21-82428B59	.01 uF +80-20%; 200 V
C466	21-82610C23	6.8 ±.5%; 200 V
C467	21-82187B07	470 ±10%
C468	21-82610C23	6.8 ±0.5; 200 V
		DIODE: (SEE NOTE)
CR401	48-863030	germanium
CR402, 403		NOT USED
CR404, 405	48-82139G01	germanium
		COIL, rf:
E401	24-84392B06	40 turns on 820 ohm resistor
E402L	24-84392B13	15 turns on 560 ohm resistor
E402H	24-84392B05	9 turns on 560 ohm resistor
		CONNECTOR, receptacle:
J401		NOT USED
J402	9-84207H01	7 contacts
		COIL, rf:
L401	24-84389B02	18-2/3 turns; coded Black
L402	24-84389B01	18-1/2 turns; coded Yellow
L403	24-84389B06	8-2/3 turns; coded Green
L404	24-84389B05	8-1/2 turns; coded Red
L405, 406	24-84972A09	6-1/2 turns; coded Yellow
L407, 408	24-84972A11	3-1/2 turns; coded Green
L409		NOT USED
L410	24-80900A61	0.62 mH
L411, 412	24-82835G08	2, 6 uH; coded Red-Blue-Gold
L413	24-84923C01	1-1/2 turns
		CONNECTOR, plug:
P401		part of printed circuit board
P402	28-84282D01	phono
P403, 902		part of printed circuit board
		TRANSISTOR: (SEE NOTE)
Q401	48-869642	NPN; type M9642
Q402, 403		NOT USED
Q404	48-869571	PNP; type M9571
Q405	48-869534	NPN; type M9534
Q406	48-869390	NPN; type M9390
Q407, 408	48-869867	NPN; type M9867
		RESISTOR, fixed: ±10%, 1/4 W unless otherwise stated
R401	6-124C43	560
R402	6-124A37	330 ±5%
R403	6-124A79	18k ±5%
R404	6-124A87	39k ±5%
	or6-124A89	47k ±5%
R405	6-124A85	33k ±5%
	or6-124A89	47k ±5%
R406	6-124A99	120k ±5%
R407	6-124B04	180k ±5%
R408	6-124C73	10k
R409	6-124C83	27k
R410	18-83083G24	variable: 25k ±30%
R411 thru 418		NOT USED
R419 thru 422	6-124A79	18k ±5%
R423	6-124C57	2.2k
R424	6-124C85	33k
R425	6-124C51	1.2k
R426	6-124C47	820
R427		NOT USED
R428	6-124C87	39k
R429	6-124C57	2.2k
R430	6-124C35	270
R431	6-124C89	47k
R432	6-124C63	3.9k
R433		NOT USED
R434	6-124C39	390
R435L	6-124C09	22
R435H	6-124C15	39
R436	6-125C05	15; 1/2 W
R437	6-124C96	82k
R438	6-124C49	1k
R439L	6-124C49	1k
R439H	6-124C41	470
		SYMMETRICAL CLIPPER AND SPLATTER FILTER:
U401	1-80763B05	potted unit

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
		NON-REFERENCED ITEMS
	14-861196	INSULATOR, transistor; 2 req'd. (used with Q407 & Q408)
	26-83379H01	HEAT SINK (used with Q408)
	26-84598A01	SHIELD, coil; 4 req'd. (used with L405 thru L408)
	26-84598A02	SHIELD, coil; 4 req'd. (used with L401 thru L404)
	42-84284B01	RETAINER; 4 req'd.
	3-138162	SCREW, tapping: Phillips round hd., 4-40 x 3/8"; 4 req'd. (used for mounting Retainers)
	55-84300H01	HANDLE
	30-83794C01	CABLE, coaxial; 6" req'd. (used with P402)
	29-84028H01	TERMINAL, pin; 19 req'd.
	29-84028H02	TERMINAL, pin; 12 req'd.
	29-855943	TERMINAL, pin; 16 req'd.
	39-10184A10	CONTACT, terminal; 10 req'd.

NOTE: For optimum performance, replacement diodes and transistors must be ordered by Motorola part numbers.

REVISIONS PEPS-18716-B

DIAG ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	TLD5491A TLD5492A	R426	FROM 6-124C85; 33k TO 6-124C37; 39k	PARTS LIST
		R437	FROM 6-124C97; 100k TO 6-124C94; 82k	
		C466	FROM 21-82428B28; .001 uF; ±10%; 500 V TO 21-82610C23; 6.8 pF; ±.5%; 200 V	
B		R401, R405	ALTERNATE 6-124A89 47k ±5% 1/4 W ADDED	



TRIPLER/LOW LEVEL AMPLIFIER ASSEMBLY

TLE1600A SERIES

FUNCTION -

Triples exciter output frequency and amplifies that signal to drive the following PA.

EXCITER/1ST BANDPASS FILTER

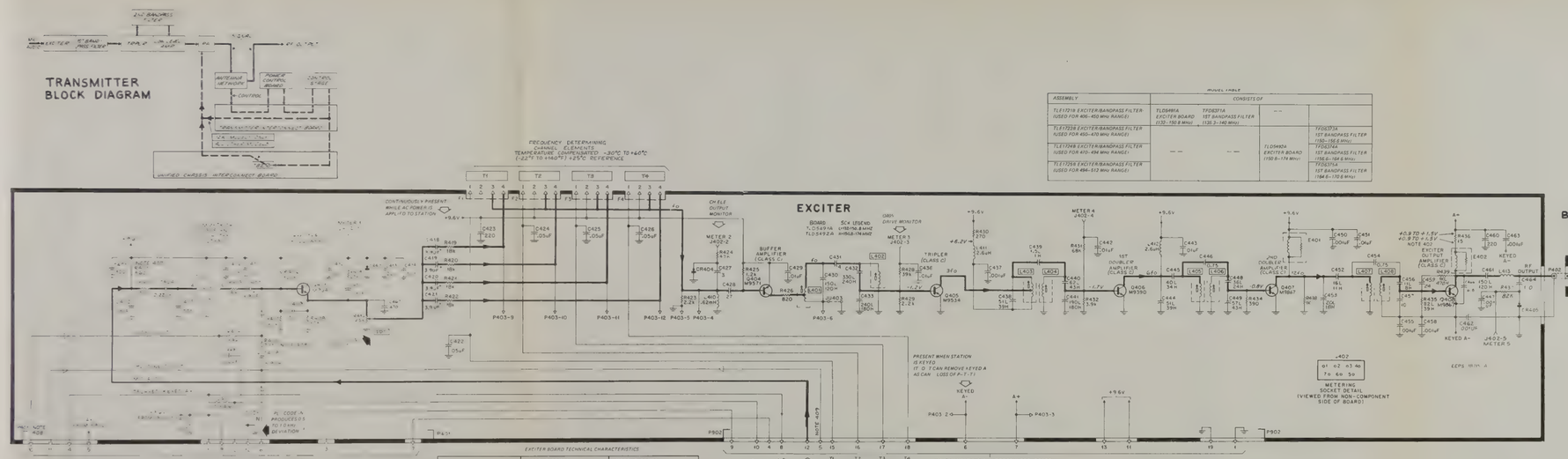
TLE1720A SERIES

TRIPLER/LOW LEVEL AMP

FUNCTION -

Exciter -- Produces modulated RF signal in 135-171 MHz range.

1st Bandpass Filter -- Attenuates signals outside the bandpass range.



MODEL TABLE			
ASSEMBLY	CONSISTS OF		
TLE1721B EXCITER/BANDPASS FILTER (USED FOR 406-450 MHz RANGE)	TLD5491A EXCITER BOARD (132-150.8 MHz)	TFD837A 1ST BANDPASS FILTER (135.3-140 MHz)	---
TLE1723B EXCITER/BANDPASS FILTER (USED FOR 450-470 MHz RANGE)	---	---	TFD837A 1ST BANDPASS FILTER (150-156.6 MHz)
TLE1724B EXCITER/BANDPASS FILTER (USED FOR 470-494 MHz RANGE)	---	TLD5492A EXCITER BOARD (150.8-174 MHz)	TFD837A 1ST BANDPASS FILTER (156.6-164.6 MHz)
TLE1725A EXCITER/BANDPASS FILTER (USED FOR 494-512 MHz RANGE)			TFD837A 1ST BANDPASS FILTER (164.6-170.8 MHz)

EXCITER BOARD TECHNICAL CHARACTERISTICS		
	MODEL TLD5491A	MODEL TLD5492A
FREQUENCY	135-150.8 MHz (TRIPLED LATER)	150.8-171 MHz (TRIPLED LATER)
NUMBER OF CHANNELS	1 TO 6	
MAXIMUM FREQUENCY SEPARATION	2500 kHz	
OSCILLATOR FREQUENCY	11-14.5 MHz	
FREQUENCY MULTIPLICATION	12 TIMES	
OUTPUT POWER	400 MILLIWATTS (OUT OF 1ST BANDPASS FILTER)	
OUTPUT IMPEDANCE	50 OHMS	
MODULATION TYPE	DIRECT FM CHANNEL ELEMENTS	
DEVIATION	±5 kHz ADJUSTABLE INSTANTANEOUS DEVIATION LIMITING	
AUDIO RESPONSE	6 dB/OCTAVE PRE EMPHASIS 300 TO 3000 Hz	
AUDIO SENSITIVITY	120 MILLIVOLTS (-3dB FOR ±20 kHz DEVIATION	
AUDIO DISTORTION	LESS THAN 3% AT ±3 kHz DEVIATION FROM 300 TO 3000 Hz	
POWER REQUIREMENTS	REGULATED +9.6 VOLTS DC @ 150 mA +13.8 VOLTS DC @ 100 mA	
METERING	FIVE TEST POINTS CRITICAL TO OPERATION AND ALIGNMENT ARE ACCESSIBLE AT A METERING RECEPTACLE WHICH PERMITS TESTING WITH AN OPTIONAL BUILT-IN STATION METER, MOTOROLA PORTABLE TEST SET: OR 0-50 uA MICROAMMETER WITH 2 000 OHMS INTERNAL RESISTANCE	
FREQUENCY CALCULATION	$f_o = 12 f_x$ $f_x = m f_c$ $f_c = f_o - 12$ $m = 12$ f_o = CARRIER FREQUENCY f_x = OSCILLATOR CRYSTAL FREQUENCY f_c = EXCITER OUTPUT FREQUENCY	

NOTES

401 FREQUENCY CALCULATIONS GIVEN IN ACCOMPANYING TECHNICAL CHARACTERISTICS TABLE. NOTE THAT OUTPUT OF EXCITER IS 12 f_c AND NOT FINAL CARRIER FREQUENCY. A FOLLOWING TRIPLER STAGE MULTIPLIES EXCITER OUTPUT TO THE CARRIER FREQUENCY

402 VOLTAGE MEASURED ACROSS R436

403 HIGH IMPEDANCE TRANSISTORIZED VOLTMETERS (11 MEGOHM) NOT RECOMMENDED

404 UNLESS OTHERWISE STATED, VOLTAGES MEASURED IN RESPECT TO CHASSIS GROUND

405 UNLESS OTHERWISE STATED CAPACITOR VALUES ARE IN PICOFARADS

406 JUMPER REMOVED IN "PRIVATE-LINE" RADIOS

407 R401 REMOVED IN REMOTE CONTROL STATIONS

408 WHEN CODE INPUTS ARE APPLIED VIA PIN 10, R405 MUST BE REMOVED FROM THE CIRCUIT

409 IN "PRIVATE-LINE" RADIOS P902-5 IS NOT CONNECTED TO THE TRANSMITTER INTERCONNECT BOARD

LEGEND

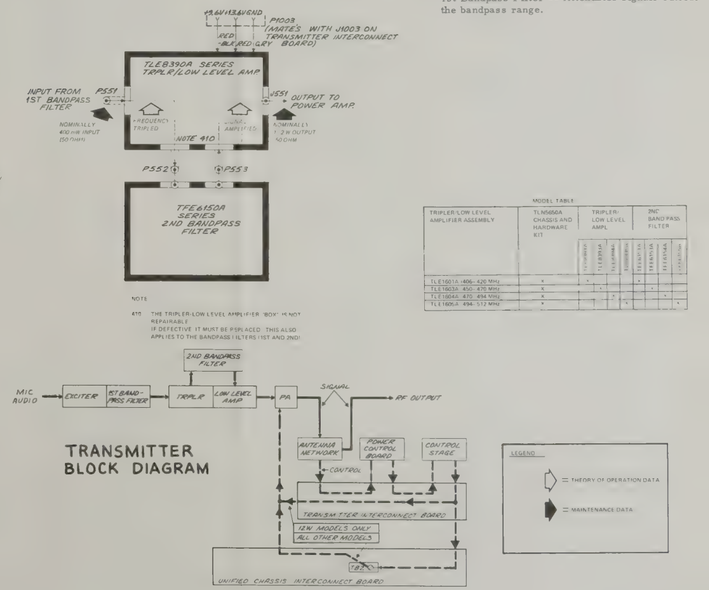
START - CIRCUIT THEORY MOST EASILY UNDERSTOOD BY BEGINNING AT THIS POINT AND FOLLOWING SIGNAL FLOW

= THEORY OF OPERATION DATA

= MAINTENANCE DATA

= PRIMARY SIGNAL FLOW

= SECONDARY SIGNAL FLOW


+9.6V KEYED A+
P403 (MATES WITH J403 ON TRANSMITTER INTERCONNECT BOARD)
RED
BLK/RD-GRY BOARD
TLE1390A SERIES TRPLR/LOW LEVEL AMP
INPUT FROM 1ST BANDPASS FILTER
P551
NOMINAL 1 V RMS INPUT (50 OHMS)
FREQUENCY TRIPLED
LOW LEVEL AMPLIFIED
NOTE 410
J551
OUTPUT TO POWER AMP.
NOMINAL 1 V RMS OUTPUT 50 OHMS
P552
P553
TFE6150A SERIES 2ND BANDPASS FILTER
NOTE
410 THE TRIPLER/LOW LEVEL AMPLIFIER "BOX" IS NOT REPAIRABLE IF DEFECTIVE IT MUST BE REPLACED. THIS ALSO APPLIES TO THE BANDPASS FILTERS (1ST AND 2ND)

MODEL TABLE							
TRIPLER/LOW LEVEL AMPLIFIER ASSEMBLY	TLN5860A CHASSIS AND HARDWARE KIT	TRIPLER/LOW LEVEL AMPL				2NC BAND PASS FILTER	
		TLE1390A	TLE1391A	TLE1392A	TLE1393A	TFE6150A	TFE6151A
TLE1601A (406-420 MHz)	X	X				X	
TLE1603A (450-470 MHz)	X		X				X
TLE1604A (470-494 MHz)	X			X			
TLE1605A (494-512 MHz)	X				X		

TRANSMITTER BLOCK DIAGRAM

PA CABLE KITS

CE L	MOTOROLA PART NO.	DESCRIPTION
A Metering and Cable Kit		PL-3430-O
		CAPACITOR, fixed:
	21-821474	470 pF ±20%; 500 V
	21-84211B03	3500 pF; 250
527,	21-861219	1000 pF; 500 V; coded RED
		CONNECTOR, receptacle:
	9-84207B01	female; 7 contact
		CONNECTOR, plug:
	28-84967D01	male BNC type
		RESISTOR, fixed:
	6-124A33	220 ±5%; 1/4 W
	6-124D12	390k ±10%; 1/4 W
	17-82620B03	.02 ±5%; 3 W
	6-84605E01	meter shunt; .006 ±1%
		TERMINAL BOARD
	31-50378	2 screw barrier type
		CABLE, ASSEMBLY RF:
	1-80775B41	includes: 30-84173F01 CABLE, coaxial, 12" long and P501
	NON-REFERENCED ITEMS	
	76-83960B01	FERRITE CORE; 9 req'd.
	42-10217A02	STRAP, cable harness; 2 req'd.
	43-82253C07	BUSHING; 2 req'd.
	15-82737K01	COVER, end cap
	47-84475E01	BUS BAR
	14-84548A01	INSULATOR, washer; 2 req'd.
	14-82975K01	INSULATOR, terminal strip
	42-38764	CLAMP, cable

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
TKN6768A Metering and Cable Kit		PL-3428-O
		CAPACITOR, fixed: pF ±20%; 500 V; unless otherwise stated
C1 thru 5	21-821474	470
C6, 7	21-84211B03	3500; 250 V
C8, 9, 10, 527, 536, 543, 546, 548	21-861219	1000 +100-0%
		CONNECTOR, receptacle:
J1	9-84207B01	7 contacts
		CONNECTOR, plug:
P501, 502	28-84967D01	BNC type
		RESISTOR, fixed:
R1	6-124A33	220 ±5%; 1/4 W
R2	6-124D12	390k ±10%; 1/4 W
R518	17-82620B03	.02 ±5%; 3 W
R519	6-84605E01	meter shunt; .008 ±1%
R520	6-84606E01	meter shunt; .004 ±1%
		TERMINAL BOARD:
TB1	31-50378	2 screw barrier type
		CABLE ASSEMBLY, rf:
W501	1-80775B41	includes: 30-84173F01 CABLE, coaxial, 12" long and P501
	NON-REFERENCED ITEMS	
	76-83960B01	FERRITE BEAD; 5 req'd.
	1-80775B44	BUS BAR, 75 W
	30-84173F01	CABLE, coaxial (used with P501 & P502)
	42-10217A02	STRAP, cable; 2 req'd.
	43-82253C07	BUSHING, threaded; 2 req'd.
	15-82737K01	COVER, end cap
	14-84548A01	INSULATOR, washer; 2 req'd.
	14-82975K01	INSULATOR, terminal strip
	42-38764	CLAMP, cable

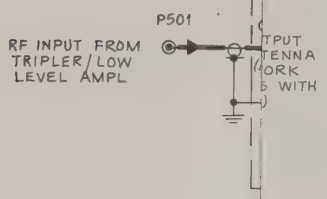
A Cable Kit (12 W Power Amplifier)		PL-3434-O
,	21-861219	CAPACITOR, feed-thru: 1000 pF; GMV; 500 V; coded RED
		CONNECTOR, plug:
	9-84886E01	female; right-angle
	28-83099K01	BNC type; imped. 50 ohms includes: 15-83498F07 INSULATOR, connector; 29-83499F01 CONTACT, terminal; 3 req'd. and 46-84549F01
	NON-REFERENCED ITEMS	
	1-80775B34	BRACKET & CAPACITOR ASSY., includes referenced items C527, C536, C548, C549 and 7-82648K01 BRACKET
	1-80775B33	CABLE & CONNECTOR ASSY., includes referenced item P505 and 42-10217A02 STRAP, cable harness; 2 req'd.
	1-80775B35	CABLE & CONNECTOR ASSY., includes referenced item P501 and 30-83794C01 CABLE, coaxial (7")
	1-80775B36	CABLE & CONNECTOR ASSY., includes referenced item P502 and 30-83794C01 CABLE, coaxial (7")

12-WATT POWER AMPLIFIER

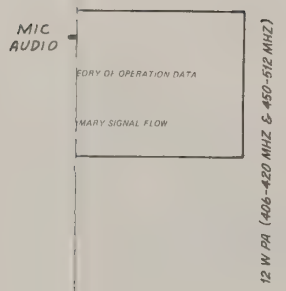
TLE1680A SERIES

FUNCTION -

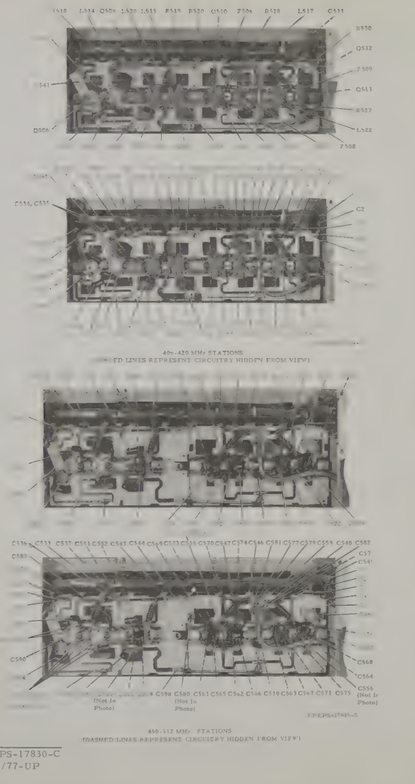
Provides final transmitter output power amplification.



MICROSTRIP AND HEAT SINK KIT		
TLE-8301A	TLE 8303A	TLE 8304A
X		
	X	
		X



PA MICROSTRIP AND HEATSINK



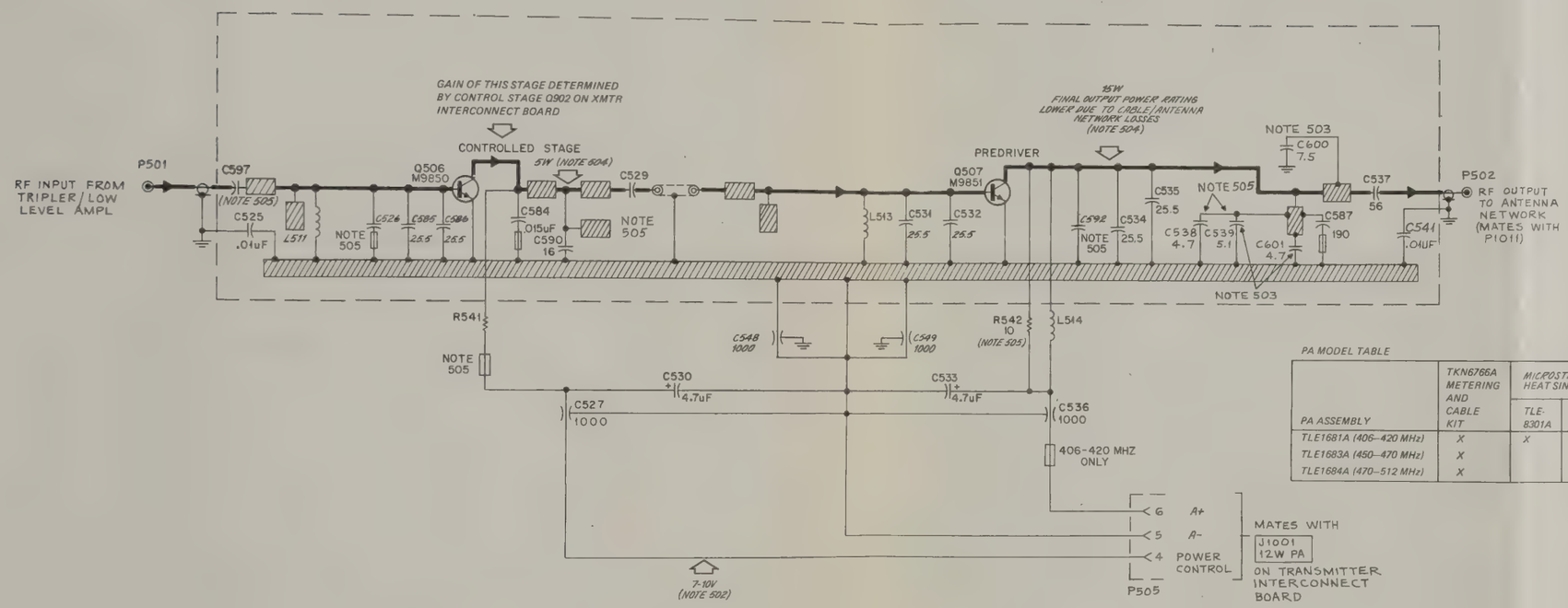
12-WATT POWER AMPLIFIER

TLE1680A SERIES

FUNCTION -

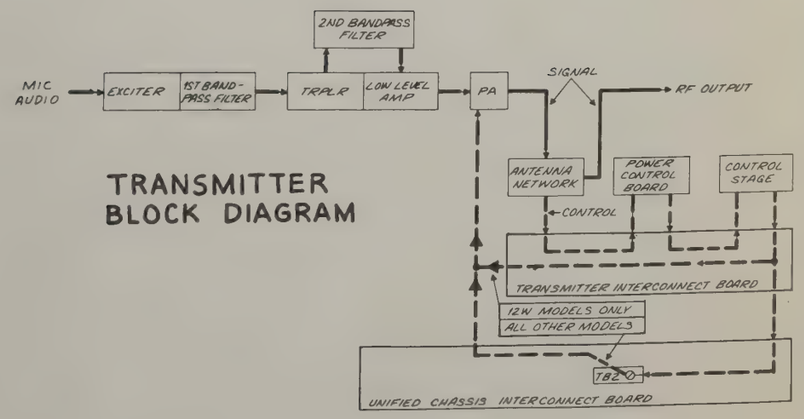
Provides final transmitter output power amplification.

PA OUTPUT IS METERED AT POWER CONTROL BOARD METERING SOCKET



PA MODEL TABLE

PA ASSEMBLY	TKN6766A METERING AND CABLE KIT	MICROSTRIP AND HEAT SINK KIT		
		TLE-8301A	TLE-8303A	TLE-8304A
TLE1681A (406–420 MHz)	X	X		
TLE1683A (450–470 MHz)	X		X	
TLE1684A (470–512 MHz)	X			X



TRANSMITTER BLOCK DIAGRAM

EEPS-17180-B

NOTES

501. UNLESS OTHERWISE STATED, CAPACITOR VALUES ARE IN PICOFARADS.

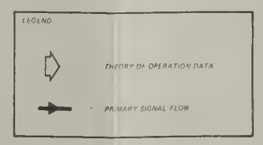
502. VOLTAGE DEPENDENT ON FINAL OUTPUT POWER, ERP, OR CONTROLLED STAGE GAIN. 470–512 MHz FREQUENCY RANGE STATIONS HAVE A HIGHER NOMINAL VOLTAGE

503. 450–470 MHz STATIONS ONLY

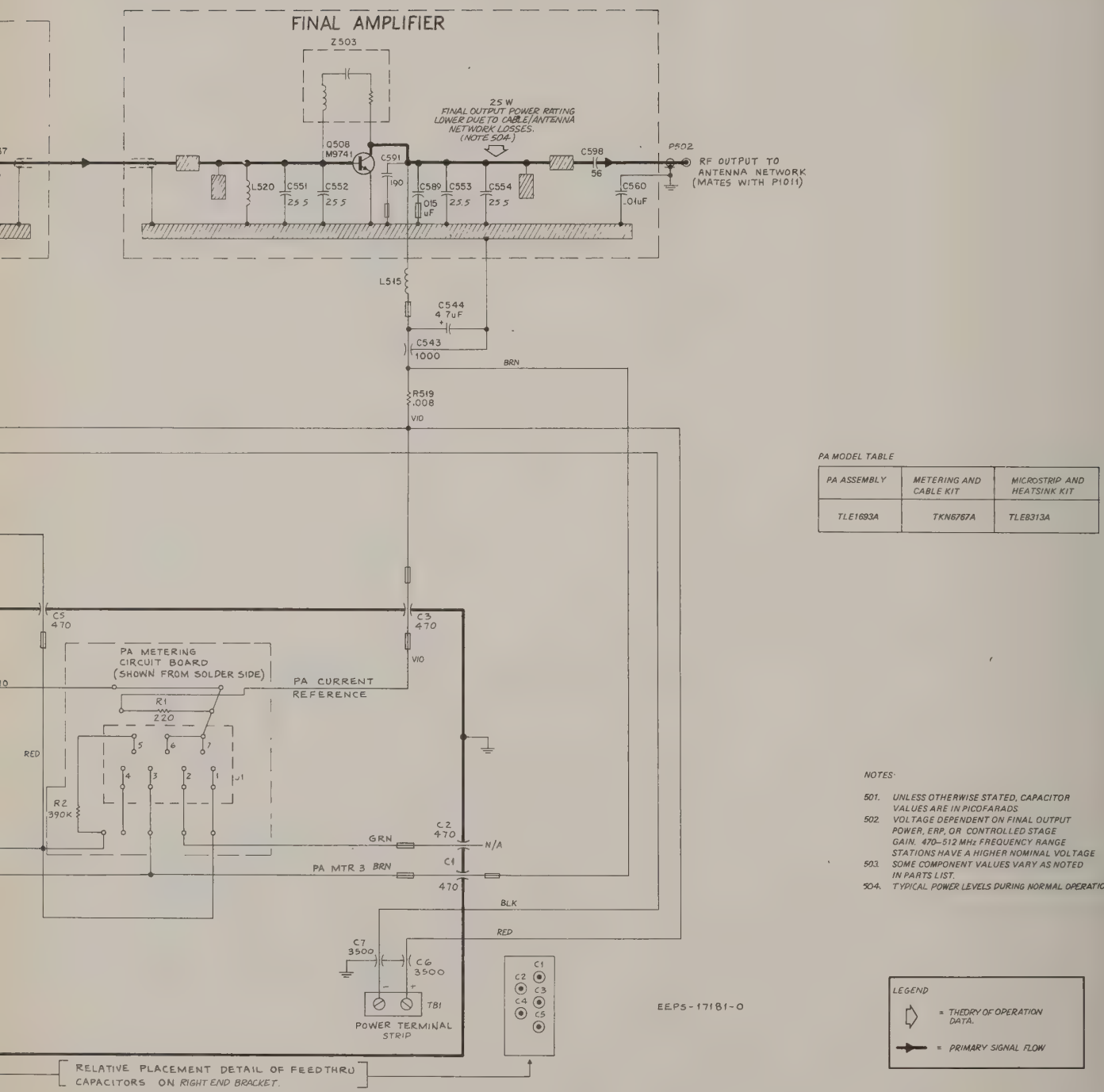
504. POWER LEVELS GIVEN ARE TYPICAL DURING NORMAL OPERATION

505.

COMPONENT	406–420 MHz	450–470 MHz	470–512 MHz
C526	NOT USED	120 pF	120 pF
C529	28 pF	56 pF	25.5 pF
C538	NOT USED	4.7 pF	NOT USED
C539	16 pF	5.1 pF	NOT USED
C592	8 pF	NOT USED	NOT USED
C597	NOT USED	56 pF	56 pF
R521	120	NOT USED	NOT USED
R540	NOT USED	NOT USED	NOT USED
R541	1.5 OHM (WITH BEND)	2 OHM	2 OHM
R42	NOT USED	10 OHM	10 OHM



12 W PA (406-420 MHZ & 450-512 MHZ)



PA MODEL TABLE

PA ASSEMBLY	METERING AND CABLE KIT	MICROSTRIP AND HEATSINK KIT
TLE1693A	TKN6767A	TLE8313A

NOTES:

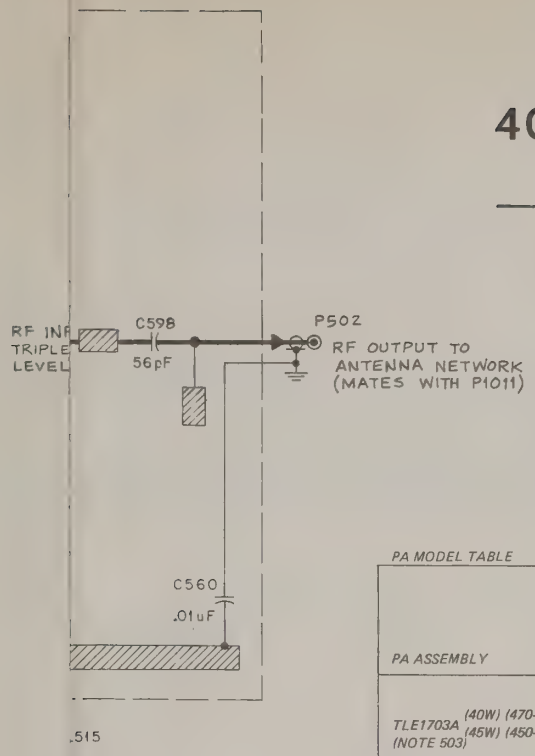
501. UNLESS OTHERWISE STATED, CAPACITOR VALUES ARE IN PICOFARADS.
502. VOLTAGE DEPENDENT ON FINAL OUTPUT POWER, ERP, OR CONTROLLED STAGE GAIN. 470–512 MHz FREQUENCY RANGE STATIONS HAVE A HIGHER NOMINAL VOLTAGE
503. SOME COMPONENT VALUES VARY AS NOTED IN PARTS LIST.
504. TYPICAL POWER LEVELS DURING NORMAL OPERATION

LEGEND

= THEORY OF OPERATION DATA.

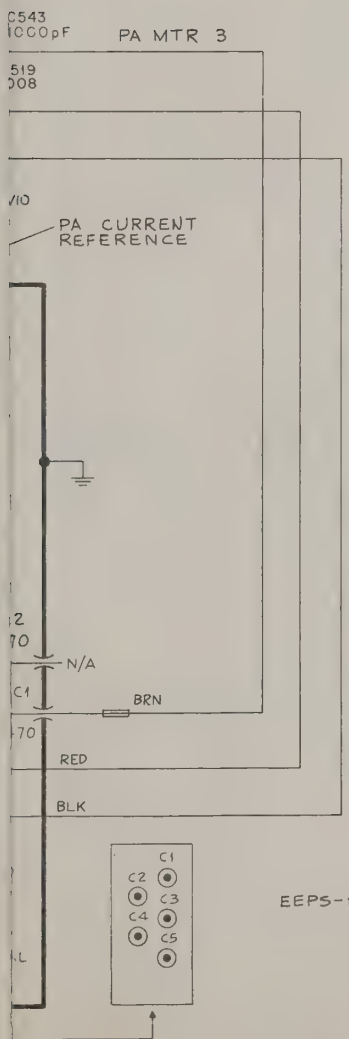
= PRIMARY SIGNAL FLOW

EEPS-17181-O



PA MODEL TABLE

PA ASSEMBLY	TKN6767A METERING AND CABLE KIT	MICROSTRIP AND HEAT SINK KIT TLE8323A
TLE1703A (NOTE 503) (40W) (470–512 MHz) (45W) (450–470 MHz)	X	X



EEPS-17182-A

NOTES:

501. UNLESS OTHERWISE STATED, CAPACITOR VALUES ARE IN PICOFARADS.
502. VOLTAGE DEPENDENT ON FINAL OUTPUT POWER, ERP, OR CONTROLLED STAGE GAIN. 470–512 MHz STATIONS HAVE A HIGHER NOMINAL VOLTAGE.
503. ONE PA IS "POWER SET" TO 45 W; THE OTHER TO 40 W. REFER TO TRANSMITTER ALIGNMENT PROCEDURE FOR DETAILS.
504. N/A
505. RF POWER LEVELS ARE TYPICAL UNDER NORMAL CONDITIONS.

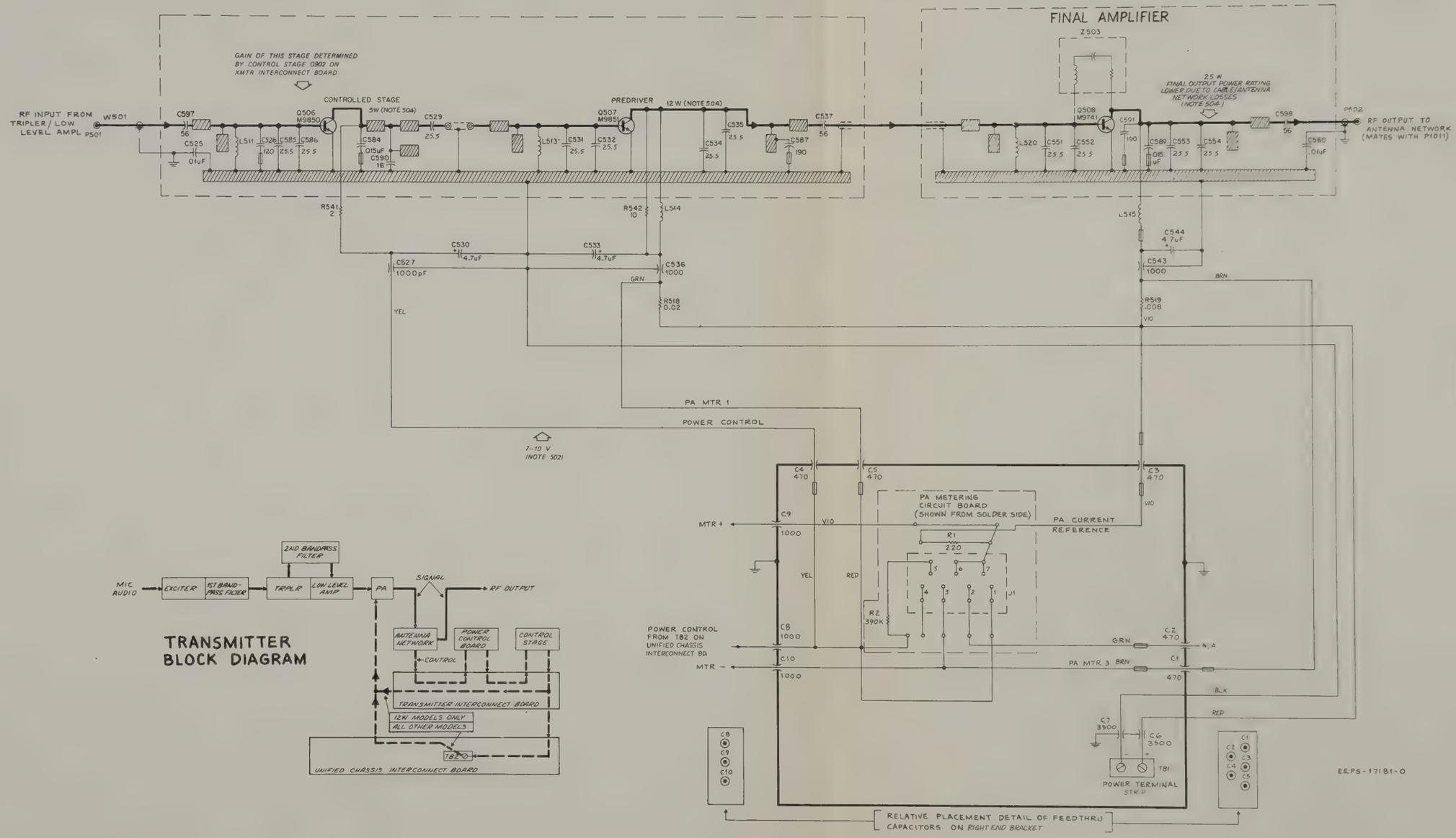
LEGEND

= THEORY OF OPERATION DATA

= PRIMARY SIGNAL FLOW

20-WATT POWER AMPLIFIER

MODEL TLE1693A



TRANSMITTER BLOCK DIAGRAM

PA MODEL TABLE

PA ASSEMBLY	METERING AND CABLE KIT	MICROSTRIP AND HEATSINK KIT
TLE1693A	TKN6767A	TLE8313A

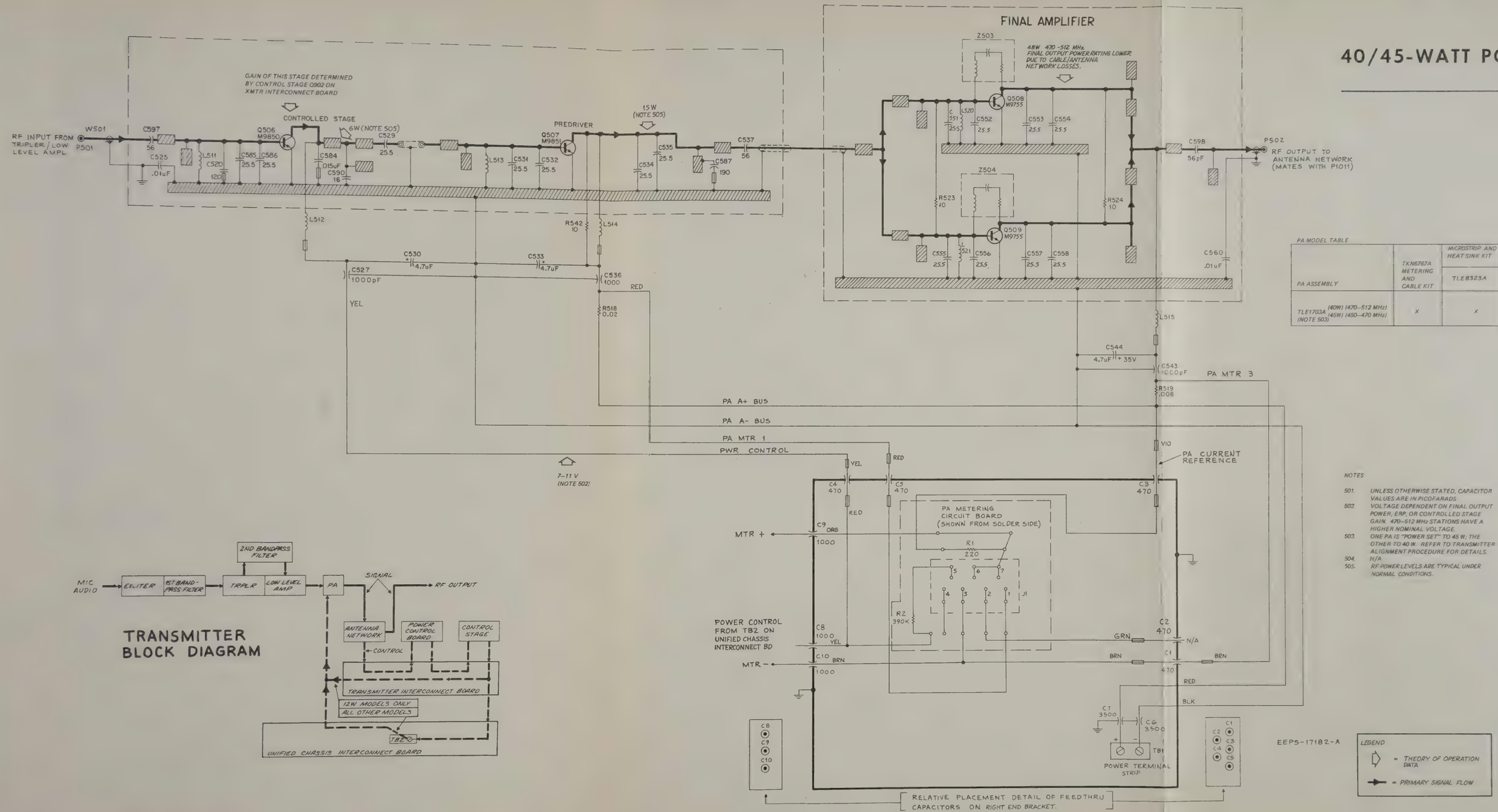
NOTES

501. UNLESS OTHERWISE STATED, CAPACITOR VALUES ARE IN PICOFARADS.
502. VOLTAGE DEPENDENT ON FINAL OUTPUT POWER, ERP, OR CONTROLLED STAGE GAIN. 470–512 MHz FREQUENCY RANGE STATIONS HAVE A HIGHER NOMINAL VOLTAGE.
503. SOME COMPONENT VALUES VARY AS NOTED IN PARTS LIST.
504. TYPICAL POWER LEVELS DURING NORMAL OPERATION.

LEGEND

= THEORY OF OPERATION DATA

= PRIMARY SIGNAL FLOW



TRANSMITTER BLOCK DIAGRAM

PA MODEL TABLE

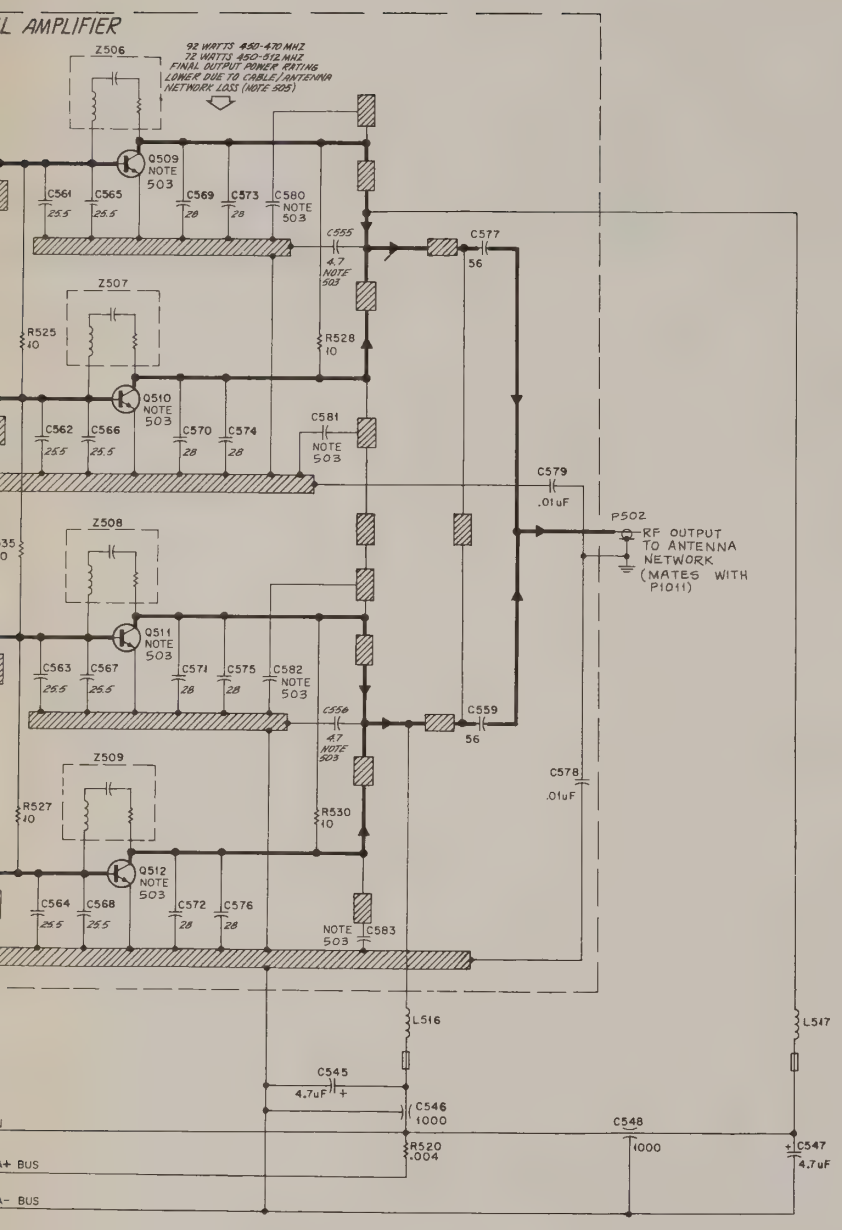
PA ASSEMBLY	TKN6767A METERING AND CABLE KIT	MICROSTRIP AND HEAT SINK KIT TLE8323A
TLE1703A (NOTE 503) (40W) (470–512 MHz) (45W) (450–470 MHz)	X	X

NOTES:

501. UNLESS OTHERWISE STATED, CAPACITOR VALUES ARE IN PICOFARADS.
502. VOLTAGE DEPENDENT ON FINAL OUTPUT POWER, ERP, OR CONTROLLED STAGE GAIN. 470–512 MHz STATIONS HAVE A HIGHER NOMINAL VOLTAGE.
503. ONE PA IS "POWER SET" TO 45 W; THE OTHER TO 40 W. REFER TO TRANSMITTER ALIGNMENT PROCEDURE FOR DETAILS.
504. N/A
505. RF POWER LEVELS ARE TYPICAL UNDER NORMAL CONDITIONS.

EEPS-17182-A

LEGEND
- = THEORY OF OPERATION DATA
- = PRIMARY SIGNAL FLOW



NOTES

501. UNLESS OTHERWISE SPECIFIED, CAPACITOR VALUES ARE IN PICOFARADS.
502. VOLTAGE DEPENDENT ON FINAL OUTPUT POWER, ERP, OR CONTROLLED STAGE GAIN. 470–512 MHz STATIONS HAVE A HIGHER NOMINAL VOLTAGE.
503.

COMPONENT	450–470 MHz	470–512 MHz
C580, C581, C582	6 pF	NOT USED
C583		
C510	USED	NOT USED
Q509, Q510	M9874	M9755
Q511, Q512		
R541	NOT USED	USED
L520	USED	NOT USED

504. N/A
505. RF POWER LEVELS ON EACH STAGE REPRESENT TYPICAL VALUES DURING NORMAL OPERATION.

PA MODEL TABLE

PA ASSEMBLY	TKN6768A METERING AND CABLE KIT	MICROSTRIP AND HEATSINK KIT	
		TLE8333A	TLE8334A
TLE1713A (75 W) (450–470 MHz)	X	X	
TLE1714A (60 W) (470–512 MHz)	X		X

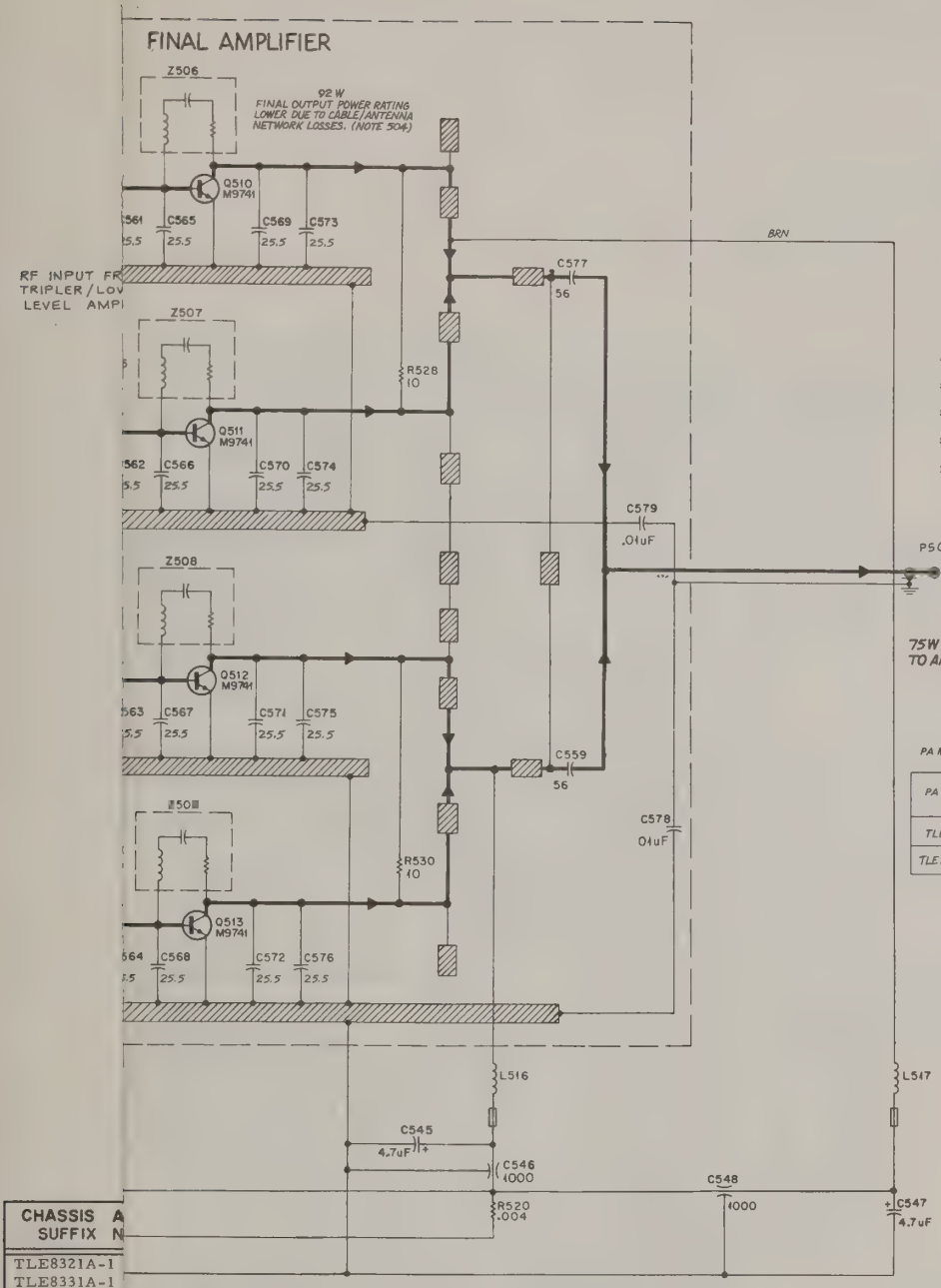
LEGEND

THEORY OF OPERATION DATA

PRIMARY SIGNAL FLOW

75-WATT POWER AMPLIFIER
MODEL TLE1711A

45-WATT POWER AMPLIFIER
MODEL TLE1701A



NOTES

501. UNLESS OTHERWISE SPECIFIED, CAPACITOR VALUES ARE IN PICOFARADS.
502. VOLTAGE DEPENDENT ON FINAL OUTPUT POWER OR CONTROLLED STAGE GAIN.
503. SOME COMPONENT VALUES VARY AS NOTED IN PARTS LIST.
504. TYPICAL POWER LEVELS DURING NORMAL OPERATION.

PA MODEL TABLE

PA ASSEMBLY	METERING AND CABLE KIT	MICROSTRIP AND HEAT SINK KIT
TLE1711A (75 W)	TKN6768A	TLE8331A
TLE1701A (45 W)	TKN6767A	TLE8321A

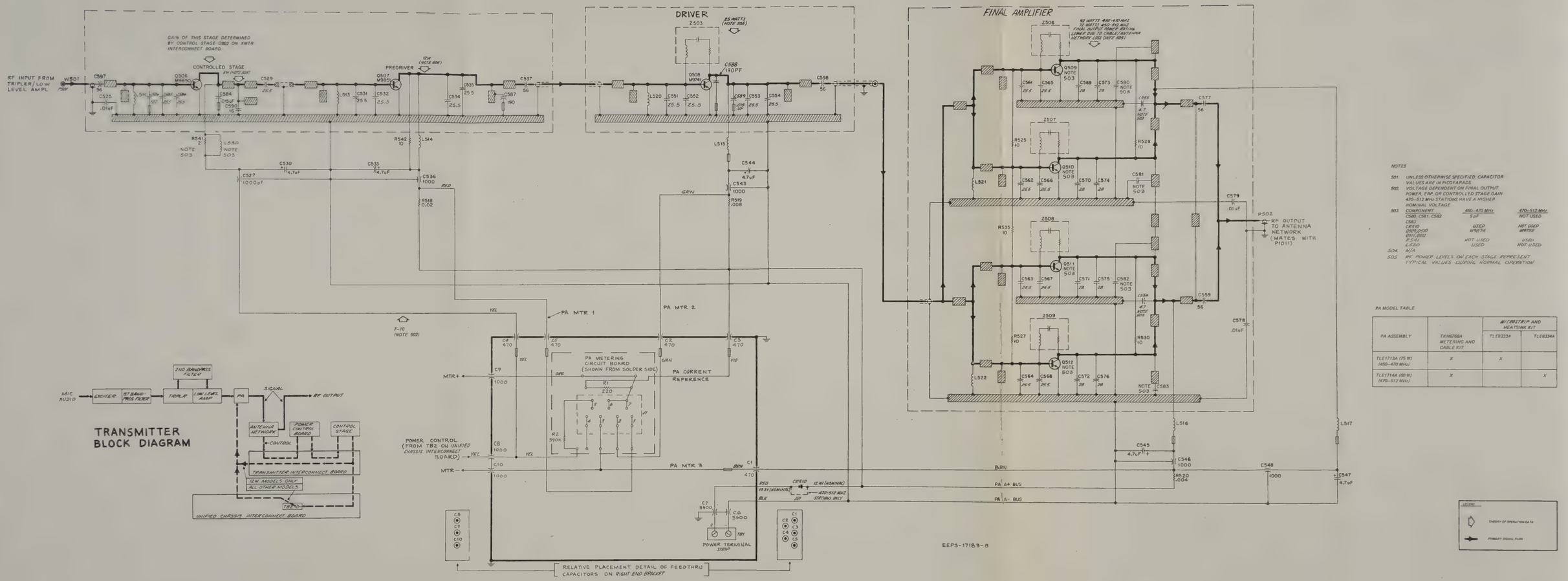
CHASSIS A SUFFIX N
TLE8321A-1
TLE8331A-1

EEPS-17234-A

LEGEND
= THEORY OF OPERATION DATA
= PRIMARY SIGNAL FLOW

60/75-WATT POWER AMPLIFIER

MODELS TLE1713A AND TLE1714A



NOTES

501. UNLESS OTHERWISE SPECIFIED, CAPACITOR VALUES ARE IN PICOFARADS.

502. VOLTAGE DEPENDENT ON FINAL OUTPUT POWER, ERP, OR CONTROLLED STAGE GAIN. 470–512 MHz STATIONS HAVE A HIGHER NOMINAL VOLTAGE.

503.

COMPONENT	450–470 MHz	470–512 MHz
C580, C581, C582	1 pF	NOT USED
C583		
CR510	USED	NOT USED
Q507, Q510	MRF874	MRF755
Q511, Q512		
R541	NOT USED	USED
L530	USED	NOT USED

504. N/A

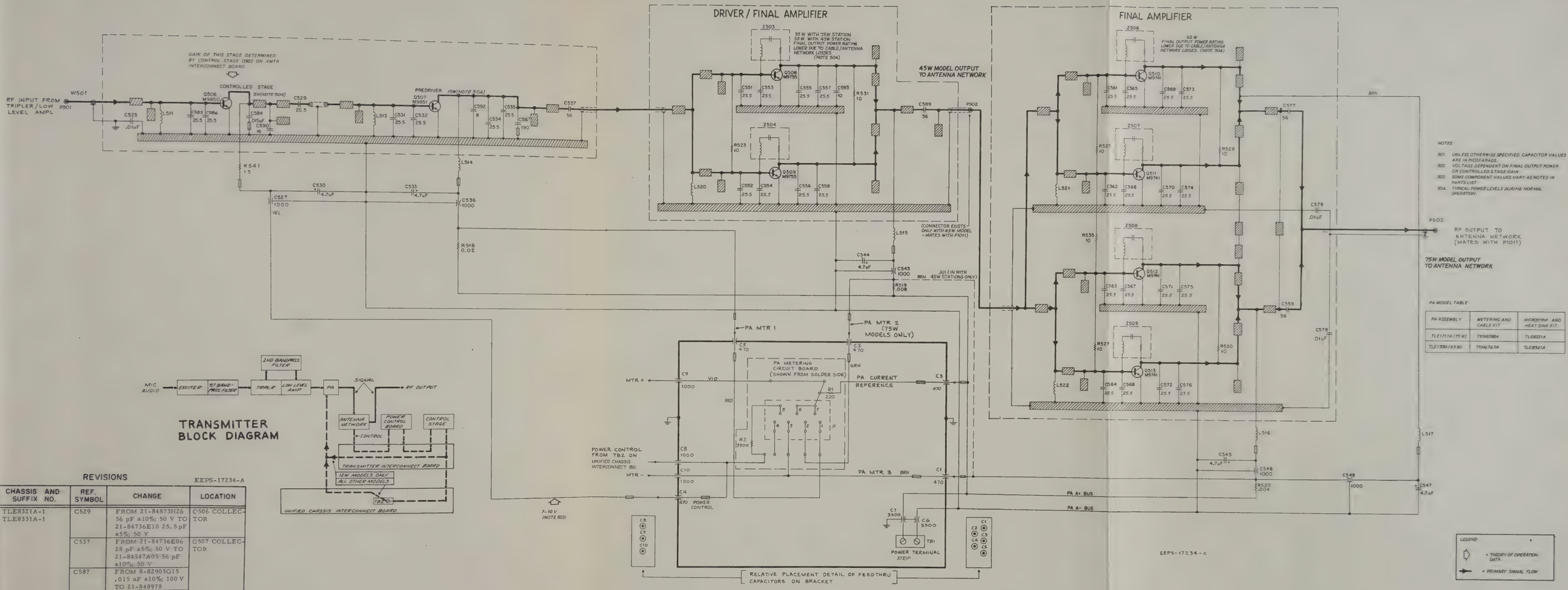
505. RF POWER LEVELS ON EACH STAGE REPRESENT TYPICAL VALUES DURING NORMAL OPERATION.

PA MODEL TABLE

PA ASSEMBLY	TKH6758A METERING AND CABLE KIT	MICROSTRIP AND HEATSINK KIT	
		TLE8333A	TLE8334A
TLE1713A (75 W) (450–470 MHz)	X	X	
TLE1714A (60 W) (470–512 MHz)	X		X

LEGEND: THEORY OF OPERATION DATA; PRIMARY SIGNAL FLOW

EEPS-17183-B
1/4/77-UP


DRIVER / FINAL AMPLIFIER
FINAL AMPLIFIER
GAIN OF THIS STAGE DETERMINED BY CONTROL STAGE Q902 ON XMTR INTERCONNECT BOARD
CONTROLLED STAGE
PREDRIVER
RF INPUT FROM TRIPLER / LOW LEVEL AMPL
W501
P501
35 W WITH 75W STATION
55 W WITH 45W STATION
FINAL OUTPUT POWER RATING LOWER DUE TO CABLE/ANTENNA NETWORK LOSSES. (NOTE 504)
45W MODEL OUTPUT TO ANTENNA NETWORK
92 W
FINAL OUTPUT POWER RATING LOWER DUE TO CABLE/ANTENNA NETWORK LOSSES. (NOTE 504)
(CONNECTOR EXISTS ONLY WITH 45W MODEL – MATES WITH P101)
P502
RF OUTPUT TO ANTENNA NETWORK (MATES WITH P101)
75W MODEL OUTPUT TO ANTENNA NETWORK
PA MTR 1
PA MTR 2 (75W MODELS ONLY)
PA MTR 3
PA METERING CIRCUIT BOARD (SHOWN FROM SOLDER SIDE)
PA CURRENT REFERENCE
POWER CONTROL FROM TB2 ON UNIFIED CHASSIS INTERCONNECT BD.
7–10 V (NOTE 502)
PA A+ BUS
PA A– BUS
POWER TERMINAL STRIP
RELATIVE PLACEMENT DETAIL OF FEEDTHRU CAPACITORS ON BRACKET
EEPS-17234-A
NOTES:
501. UNLESS OTHERWISE SPECIFIED, CAPACITOR VALUES ARE IN PICOFARADS.
502. VOLTAGE DEPENDENT ON FINAL OUTPUT POWER OR CONTROLLED STAGE GAIN.
503. SOME COMPONENT VALUES VARY AS NOTED IN PARTS LIST.
504. TYPICAL POWER LEVELS DURING NORMAL OPERATION.
PA MODEL TABLE
PA ASSEMBLY | METERING AND CABLE KIT | MICROSTRIP AND HEAT SINK KIT
TLE1711A (75 W) | TKN6788A | TLE8331A
TLE1708A (45 W) | TKN6767A | TLE8321A
LEGEND
= THEORY OF OPERATION DATA
= PRIMARY SIGNAL FLOW

TRANSMITTER BLOCK DIAGRAM

REVISIONS

EEPS-17234-A

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLE8321A-1 TLE8331A-1	C529	FROM 21-84873H26 56 pF ±10%; 50 V TO 21-84736E10 25.5 pF ±5%; 50 V	Q506 COLLECTOR
	C537	FROM 21-84736E06 28 pF ±5%; 50 V TO 21-84547A05 56 pF ±10%; 50 V	Q507 COLLECTOR
	C587	FROM 8-82905G15 .015 uF ±10%; 100 V TO 21-848978	
	C592	FROM 21-832501 .01 uF +60-40%; 250 V TO 21-851846 8 pF ±0.25 pF; 500 V	
	Q506	FROM 48-869738 TO 48-869850	CONTROLLED STAGE
	Q507	FROM 48-869739 TO 48-869851	PREDRIVER
	R521	DELETED; WAS 6-125C27 120 ±10%; 1/2 W	Q506 BASE
	R541	FROM 1y-82177B53 2 OHMS ±10%; 5 W TO 17-82291B40 1.5 OHMS ±5%; 5 W	Q506 COLLECTOR

CRIPTION

L

PL-1887-E

R, fixed:
rwise stated
00 V; N220
0%; 25 V
00 V; N220
0 V
00 V; N220
5 V
00 V; N220
%; 50 V
CTOR DEVICE,
NOTE I)

er type; 9.1 V ±5%
carrier type
rolled type, anode-
M9777

D CIRCUIT:
I)

., receptacle:
ntact

R: (SEE NOTE I)
M9641
M9570

fixed: ±10%; 1/4 W;
rwise stated

0k ±30%

k ±30%

/4 W
/4 W

OR:
@25°C (17.5k ±5%

lastic (long)
lastic (short)

POWER CONTROL BOARD
FUNCTIONAL DESCRIPTION

The power control board operates as a control loop which continually monitors the output from the final stages of the transmitter power amplifier (via the antenna network) and controls that output by regulating the gain of the first stage of the power amplifier, Q506. The output of the integrated circuit differential amplifier (IC601) amplified by the dc amplifier (Q601) is the controlling input for control stage transistor Q902. Q902 determines the A+ applied to the first rf (controlled) stage in the power amplifier.

The output of the differential amplifier is determined by the potentials present on the non-inverting (+) and inverting (-) inputs. These potentials are developed by the power control board circuitry in the following manner.

When the impedances of the antenna circuitry (load) provide a good match to the power amplifier (low VSWR) a bias voltage produced by dc reference bias circuitry is placed on the inverting input (pin 1 which is also called the reference input) of the differential amplifier.

When the transmitter is keyed, the forward (output) power from the final stages of the power amplifier is fed through the antenna network to the antenna circuit. This flow of power is sampled by the forward power sampling circuitry and places a bias, proportional to the forward power in the antenna network on the non-inverting input (pin 5) of the differential amplifier. The power set potentiometer is then adjusted, changing the potential on the non-inverting input. As this voltage changes, relative to the reference input voltage, the output of the differential amplifier changes, in turn changing the control transistor collector voltage and therefore the output of the power amplifier.

Once the power has been set to the proper level, any change in the output power will be instantly corrected by the circuitry. If the power increases, the increase causes the differential amplifier output voltage to increase, decreasing the output from the dc amplifier, increasing the output from the control stage, which decreases the gain of the power amplifier until the output returns to the preset level. A decrease in transmitter power amplifier output causes the reverse action.

Any power reflected back from the antenna circuit is detected by the reverse power sampling circuit. Reverse power causes a bias in the antenna network which decreases the potential on the reference input of the differential amplifier. Therefore, increasing levels of reflected power will cause the transmitter power output to be decreased to a safe level.

POWER CONTROL BOARD
MODEL TLN4926A
ANTENNA NETWORK
TLE1670A SERIES (RPTR STA'S)
TLE1660A SERIES (BASE STA'S)
CONTROL STAGE
P/O MODEL TLN5649A CHASSIS & HDW

FUNCTION -

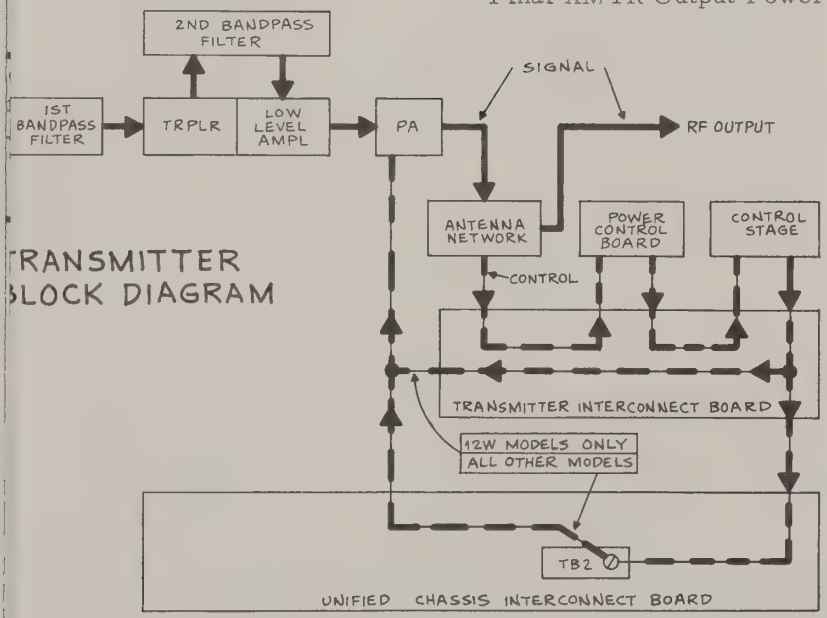
Power Control Board
- --Power Leveling
- --VSWR Protection
- --Drive Limiting
- --Forward and Reverse Power Metering
- --No Power Output Protection Circuitry

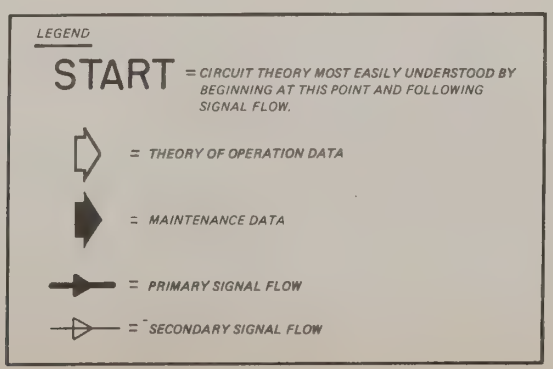
Antenna Network
- --Provides DC voltages proportional to forward and reverse power
- --Attenuates transmitter carrier harmonics to a level of at least -85 dB below the carrier (harmonic filter)
- --Provides the transmitter final power output stage with a low VSWR 50-ohm load during transmit independent of the load presented to the XMIT antenna.

Control Stage Regulates Drive to PA and thus, Final XMTR Output Power.

TR STATIONS)
SE STATIONS)

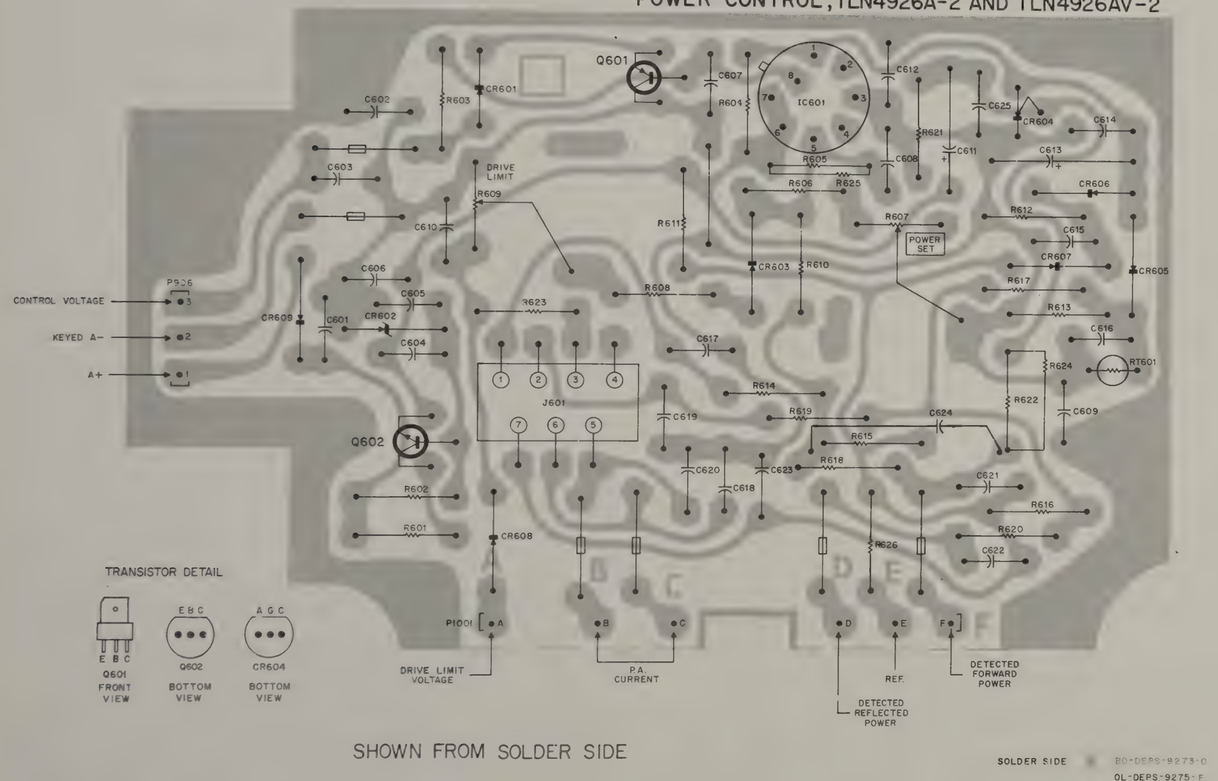
TRANSMITTER
BLOCK DIAGRAM




LEGEND
START = CIRCUIT THEORY MOST EASILY UNDERSTOOD BY BEGINNING AT THIS POINT AND FOLLOWING SIGNAL FLOW.
= THEORY OF OPERATION DATA
= MAINTENANCE DATA
= PRIMARY SIGNAL FLOW
= SECONDARY SIGNAL FLOW

POWER CONTROL BOARD
MODEL TLN4926A
ANTENNA NETWORK
TLE1670A SERIES
TLE1660A SERIES
CONTROL STAGE
P/O MODEL TLN5649A CHASSIS & HDW

POWER CONTROL, TLN4926A-2 AND TLN4926AV-2



TRANSISTOR DETAIL

SHOWN FROM SOLDER SIDE

SOLDER SIDE

80-DEPS-9273-D
OL-DEPS-9275-F

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		POWER CONTROL
TLN4926A Power Control Board		PL-1887-E
		CAPACITOR, fixed: unless otherwise stated
C601 thru 606	21-82610C04	36 pF ±5%; 200 V; N220
C607	21-82372C04	.05 uF +80-20%; 25 V
C608, 609, 610	21-82610C04	36 pF ±5%; 200 V; N220
C611	23-82783B10	1 uF ±20%; 50 V
C612	21-82610C04	36 pF ±5%; 200 V; N220
C613	23-83214C04	1 uF ±20%; 15 V
C614 thru 623	21-82610C04	36 pF ±5%; 200 V; N220
C624	8-82905G30	0.1 uF, ±10%; 50 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE I)
CR601	48-83654H01	silicon
CR602	48-83696E04	silicon; Zener type; 9.1 V ±5%
CR603	48-84616A01	silicon; hot-carrier type
CR604	48-869777	silicon; controlled type, anode-gated; type M9777
CR605, 606, 607	48-82392B12	silicon
CR608	48-82392B03	silicon
CR609	48-82466H18	silicon
		INTEGRATED CIRCUIT: (SEE NOTE I)
IC601	51-84320A02	
		CONNECTOR, receptacle:
J601	9-84207B01	female; 7-contact
		TRANSISTOR: (SEE NOTE I)
Q601	48-869641	PNP; type M9641
Q602	48-869570	NPN; type M9570
		RESISTOR, fixed: ±10%; 1/4 W; unless otherwise stated
R601	6-129860	56
R602	6-129984	680 ±5%
R603	6-127802	1k
R604	6-129230	12k
R605	6-128902	47k
R606	6-129225	10k
R607	18-83083G20	variable: 50k ±30%
R608	6-127802	1k
R609	18-83083G14	variable: 1k ±30%
R610	6-129232	3.9k
R611	6-124A39	390 ±5%
R612	6-129984	680 ±5%
R613	6-131527	47k ±5%
R614	6-129886	27k ±5%
R615	6-129805	1k ±5%
R616	6-129804	2.2k ±5%
R617	6-129805	1k ±5%
R618	6-128686	8.2k
R619	6-131527	47k ±5%
R620	6-128686	8.2k
R621	6-127807	33k
R622	6-128685	22k
R623	6-128682	390k
R624	6-124C81	22k ±10%; 1/4 W
R625	6-124C91	56k ±10%; 1/4 W
		THERMISTOR:
RT601	6-82462G03	194k ±20% @25°C (17.5k ±5% @80°C)
		NON-REFERENCED ITEMS
	55-84300B03	HANDLE, plastic (long)
	55-84973E01	HANDLE, plastic (short)

POWER CONTROL BOARD
FUNCTIONAL DESCRIPTION

The power control board operates as a control loop which continually monitors the output from the final stages of the transmitter power amplifier (via the antenna network) and controls that output by regulating the gain of the first stage of the power amplifier, Q506. The output of the integrated circuit differential amplifier (IC601) amplified by the dc amplifier (Q601) is the controlling input for control stage transistor Q902. Q902 determines the A+ applied to the first rf (controlled) stage in the power amplifier.

The output of the differential amplifier is determined by the potentials present on the non-inverting (+) and inverting (-) inputs. These potentials are developed by the power control board circuitry in the following manner.

When the impedances of the antenna circuitry (load) provide a good match to the power amplifier (low VSWR) a bias voltage produced by dc reference bias circuitry is placed on the inverting input (pin 1 which is also called the reference input) of the differential amplifier.

When the transmitter is keyed, the forward (output) power from the final stages of the power amplifier is fed through the antenna network to the antenna circuit. This flow of power is sampled by the forward power sampling circuitry and places a bias, proportional to the forward power in the antenna network on the non-inverting input (pin 5) of the differential amplifier. The power set potentiometer is then adjusted, changing the potential on the non-inverting input. As this voltage changes, relative to the reference input voltage, the output of the differential amplifier changes, in turn changing the control transistor collector voltage and therefore the output of the power amplifier.

Once the power has been set to the proper level, any change in the output power will be instantly corrected by the circuitry. If the power increases, the increase causes the differential amplifier output voltage to increase, decreasing the output from the dc amplifier, increasing the output from the control stage, which decreases the gain of the power amplifier until the output returns to the preset level. A decrease in transmitter power amplifier output causes the reverse action.

Any power reflected back from the antenna circuit is detected by the reverse power sampling circuit. Reverse power causes a bias in the antenna network which decreases the potential on the reference input of the differential amplifier. Therefore, increasing levels of reflected power will cause the transmitter power output to be decreased to a safe level.

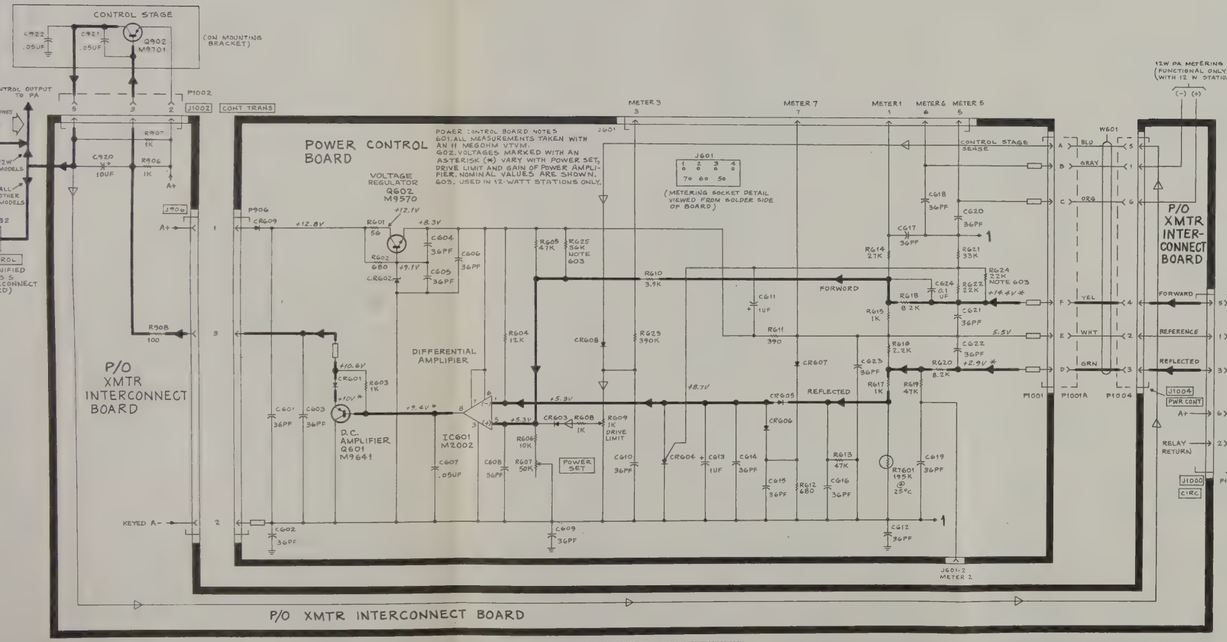
POWER CONTROL BOARD
MODEL TLN4926A
ANTENNA NETWORK
TLE1670A SERIES (RPTR STA'S)
TLE1660A SERIES (BASE STA'S)
CONTROL STAGE
P/O MODEL TLN5649A CHASSIS & HDW

FUNCTION

Power control board:
- --Power sensing
- --VSWR protect
- --Drive control
- --Provides [illegible] Power Metering
- --No Power control provided in 12 watts

Antenna switching:
- --Provides [illegible] antenna switching between receiver and transmitter
- --Provides [illegible] antenna switching between receiver and transmitter
- --Provides harmonic filtering for final power output signal.

Control Stage Regulates Drive to PA and thus, Final XMTR Output Power.


CONTROL STAGE
(ON MOUNTING BRACKET)
CONTROL OUTPUT TO PA
P1002
J1002
CONT TRANS
DETERMINED WITH CUSTOMER
12W MODELS
ALL OTHER MODELS
P/O TB2
CONTROL
(ON UNIFIED CHASSIS INTERCONNECT BOARD)
POWER CONTROL BOARD
METER 3
METER 7
METER 1
METER 6
METER 5
J601
(METERING SOCKET DETAIL VIEWED FROM SOLDER SIDE OF BOARD)
CONTROL STAGE SENSE
VOLTAGE REGULATOR Q602 M9570
+12.1V
+8.3V
+12.8V
+9.1V
+10.6V
+10V*
+9.4V*
+5.3V
+8.7V
+7.9V*
+6.4V*
5.5V
FORWARD
REFLECTED
DIFFERENTIAL AMPLIFIER
D.C. AMPLIFIER Q601 M9641
IC601 M2002
POWER SET
DRIVE LIMIT
RT601 195K @ 25°C
P/O XMTR INTERCONNECT BOARD
KEYED A-
J601-2 METER 2
W601
P/O XMTR INTER-CONNECT BOARD
FORWARD
REFERENCE
REFLECTED
RELAY RETURN
J1004
PWR CONT
J1000
CIRC
P1000
P1001
P1004A
P1004
15W PA METERING (FUNCTIONAL ONLY WITH 12 W STATIONS)
W1001
START
RF FROM PA (RPTR AND BASE STATIONS)
P1011
XMIT RF
FORWARD SENSE
A SIGNAL ENTERING PORT 1 OF THE CIRCULATOR LEAVES AT PORT 2 AND A SIGNAL ENTERING PORT 2 LEAVES AT PORT 3. IN GENERAL A SIGNAL ENTERING ANY PORT WILL LEAVE AT AN ADJACENT PORT IN THE DIRECTION OF THE ARROW.
ANTENNA NETWORK
NOTE
THE ANTENNA NETWORK CIRCUITRY IS SHOWN FOR REFERENCE ONLY, THE UNIT MUST BE REPLACED AS AN ASSEMBLY. (EXCEPT CR1001,2 & P1002)
CIRCULATOR
PORT 1
PORT 2
PORT 3
BASE STATION RCV RF
RPTR AND BASE STATION TRANSMIT RF
HARMONIC FILTER (LOW PASS)
RF TO RCVR (BASE STATIONS ONLY)
P1012
RF TO XMIT ANT (RPTR STATIONS)
RF TO/FROM ANT (BASE STATIONS)
BASE STA RCV RF
RPTR STATIONS ONLY
OR BASE STATIONS ONLY
VOLTAGE PROPORTIONAL TO FORWARD OUTPUT POWER
VOLTAGE PROPORTIONAL TO REFLECTED POWER
REFLECTED SENSE
BASE STATIONS ONLY
CIRCULATOR PORT 2
REFER TO XMTR INTERCONNECT BD SCHEMATIC DIAGRAM FOR PARTS LIST INFORMATION
DURING TRANSMIT, PORT 3 IS CONNECTED TO R1001 (DIRECTLY WITH REPEATER STATIONS, OR THROUGH A REED SWITCH WITH BASE STATIONS). THIS CIRCUIT ARRANGEMENT PROVIDES THE TRANSMITTER POWER AMPLIFIER OUTPUT STAGE WITH A LOW VSWR 50-OHM LOAD INDEPENDENT OF THE CONDITION OF THE LOAD CONNECTED TO THE ANTENNA CONNECTOR. WHENEVER A MISMATCHED LOAD APPEARS AT THE ANTENNA CONNECTOR, THE REFLECTED POWER FROM THE MISMATCHED LOAD ENTERS PORT 3 OF THE CIRCULATOR AND IS ROUTED TO PORT 3 AND TO THE 50 OHM LOAD INSIDE THE UNIT.
CURRENT LIMITER Q901
K1001
RELAY SHOWN DE-ENERGIZED (TRANSMITTER UNKEYED) WHEN DE-ENERGIZED A RECEIVED SIGNAL ENTERS THE ANTENNA CONNECTOR THROUGH THE LOW PASS FILTER AND INTO PORT 2 AND IS ROUTED THROUGH THE CIRCULATOR AND OUT PORT 3. THE SIGNAL IS THEN CONNECTED TO THE RECEIVER VIA THIS REED SWITCH.
ANTENNA SW (SW END)
MOUNTED ON XMTR INTERCONNECT BOARD
REFER TO XMTR INTERCONNECT BD SCHEMATIC DIAGRAM FOR PARTS LIST INFORMATION.
P/O ANTENNA NETWORK
BASE STATIONS ONLY
EEPS-17179-A

POWER CONTROL BOARD FUNCTIONAL DESCRIPTION

THE POWER CONTROL BOARD OPERATES AS A CONTROL LOOP WHICH CONTINUALLY MONITORS THE OUTPUT FROM THE FINAL STAGES OF THE TRANSMITTER POWER AMPLIFIER VIA THE ANTENNA NETWORK, AND CONTROLS THAT OUTPUT BY REGULATING THE GAIN OF THE FIRST STAGE OF THE POWER AMPLIFIER (D08). THE OUTPUT OF THE INTEGRATED CIRCUIT DIFFERENTIAL AMPLIFIER (IC601) AMPLIFIED BY THE DC AMPLIFIER (Q601) IS THE CONTROLLING INPUT FOR CONTROL STAGE TRANSISTOR Q902. Q902 DETERMINES THE A+ APPLIED TO THE FIRST RF (CONTROLLED) STAGE IN THE POWER AMPLIFIER.

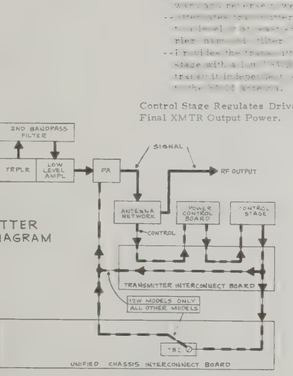
THE OUTPUT OF THE DIFFERENTIAL AMPLIFIER IS DETERMINED BY THE POTENTIALS PRESENT ON THE NON-INVERTING (+) AND INVERTING (-) INPUTS. THESE POTENTIALS ARE DEVELOPED BY THE POWER CONTROL BOARD CIRCUITRY IN THE FOLLOWING MANNER:

WHEN THE IMPEDANCES OF THE ANTENNA CIRCUITRY (LOAD) PROVIDE A GOOD MATCH TO THE POWER AMPLIFIER (LOW VSWR), A BASE VOLTAGE PRODUCED BY DC REFERENCE BIAS CIRCUITRY IS PLACED ON THE INVERTING INPUT (PIN 1 WHICH IS ALSO CALLED THE REFERENCE INPUT) OF THE DIFFERENTIAL AMPLIFIER.

WHEN THE TRANSMITTER IS KEYED, THE FORWARD (OUTPUT) POWER FROM THE FINAL STAGES OF THE POWER AMPLIFIER IS FED THROUGH THE ANTENNA NETWORK TO THE ANTENNA CIRCUIT. THIS FLOW OF POWER IS SAMPLED BY THE FORWARD POWER SAMPLING CIRCUITRY AND PLACES A BIAS, PROPORTIONAL TO THE FORWARD POWER IN THE ANTENNA NETWORK ON THE NON-INVERTING INPUT (PIN 5) OF THE DIFFERENTIAL AMPLIFIER. THE POWER SET POTENTIOMETER IS THEN ADJUSTED, CHANGING THE POTENTIAL ON THE NON-INVERTING INPUT. AS THIS VOLTAGE CHANGES, RELATIVE TO THE REFERENCE INPUT VOLTAGE, THE OUTPUT OF THE DIFFERENTIAL AMPLIFIER CHANGES; IN TURN CHANGING THE CONTROL TRANSISTOR COLLECTOR VOLTAGE AND THEREFORE THE OUTPUT OF THE POWER AMPLIFIER.

ONCE THE POWER HAS BEEN SET TO THE PROPER LEVEL, ANY CHANGE IN THE OUTPUT POWER WILL BE INSTANTLY CORRECTED BY THE CIRCUITRY. IF THE POWER INCREASES, THE INCREASE CAUSES THE DIFFERENTIAL AMPLIFIER OUTPUT VOLTAGE TO INCREASE, DECREASING THE OUTPUT FROM THE DC AMPLIFIER, INCREASING THE OUTPUT FROM THE CONTROL STAGE, WHICH INCREASES THE GAIN OF THE POWER AMPLIFIER UNTIL THE OUTPUT RETURNS TO THE PRESET LEVEL. A DECREASE IN TRANSMITTER POWER AMPLIFIER OUTPUT CAUSES THE REVERSE ACTION.

ANY POWER REFLECTED BACK FROM THE ANTENNA CIRCUIT IS DETECTED BY THE REVERSE POWER SAMPLING CIRCUIT. REVERSE POWER CAUSES A BIAS IN THE ANTENNA NETWORK WHICH DECREASES THE POTENTIAL ON THE REFERENCE INPUT OF THE DIFFERENTIAL AMPLIFIER. THEREFORE, INCREASING LEVELS OF REFLECTED POWER WILL CAUSE THE TRANSMITTER POWER OUTPUT TO BE DECREASED TO A SAFE LEVEL.



LEGEND
START = CIRCUIT THEORY MOST EASILY UNDERSTOOD BY BEGINNING AT THIS POINT AND FOLLOWING SIGNAL FLOW
= THEORY OF OPERATION DATA
= MAINTENANCE DATA
= PRIMARY SIGNAL FLOW
= SECONDARY SIGNAL FLOW

TONE "PRIVATE-LINE" ENCODER

MODEL TLN5731A

"PL" TON
FREQUEN
STABILIT
LEVEL (nominal)
OUTPUT
POWER R

1. DESCRIP

The "Priv
a low-frequenc
lation of the tr
operation.

The to
unsque
networ

2. FUNCTIO

2.1 GENER

The en
major section

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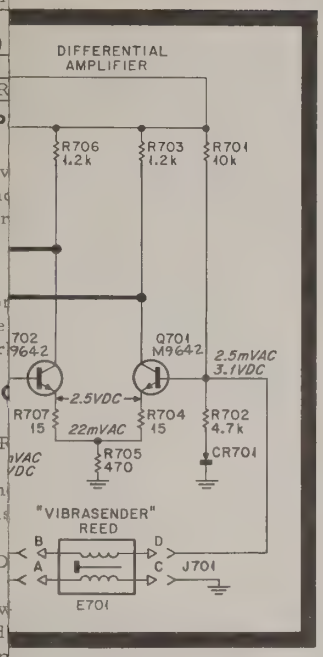

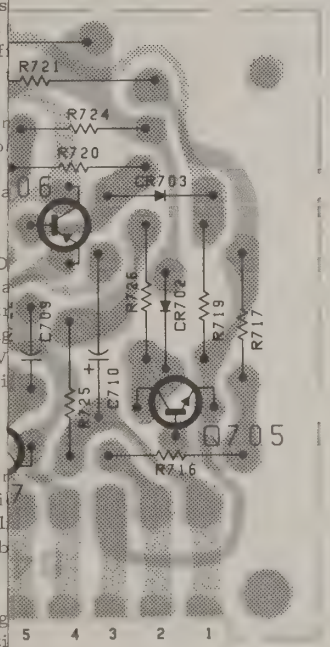

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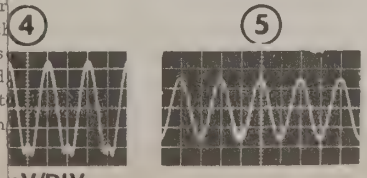


"PL" ENCODER

701. ALL AC VOLTAGE MEASUREMENTS ARE RMS VALUES. ALL AC VOLTAGES ARE SINUSOIDAL EXCEPT Q708 EMITTER. METER READING DEPENDENT UPON METER RESPONSE TO NON-SINUSOIDAL WAVE.

702. DC VOLTAGE MEASUREMENTS IN Q705, Q706 AND Q707 STAGES TAKEN WITH RESPECT TO A-. VOLTAGES FOR ALL OTHER STAGES TAKEN WITH RESPECT TO CHASSIS GROUND. ALL DC VOLTAGES MAY BE MEASURED WITH 20,000 OHM-PER-VOLTMETER OR HIGH IMPEDANCE DC VOLTMETER (11 MEGOHM) EXCEPT BASE OF Q704 WHICH CAN ONLY BE MEASURED WITH A HIGH IMPEDANCE METER.

703. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS. RESISTOR VALUES ARE IN OHMS.

704. PIN 701 IS USED ONLY FOR CERTAIN OPTIONAL EQUIPMENT.

EPS-7051-A

68P81026E71-E
1/4/77-UP

PARTS LIST

Antenna Network PL-3364-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	TLE1661A	406-420 MHz (Base Station)
	TLE1663A	450-470 MHz (Base Station)
	TLE1664A	470-494 MHz (Base Station)
	TLE1665A	494-512 MHz (Base Station)
	TLE1671A	406-420 MHz (Repeater [RT] Station)
	TLE1673A	450-470 MHz (Repeater [RT] Station)
	TLE1674A	470-494 MHz (Repeater [RT] Station)
	TLE1675A	494-512 MHz (Repeater [RT] Station)
		NOTE Field replacement of component parts of these units are not recommended (except those listed below). For replacement, order the entire unit. Specify kit numbers and frequency range required.
CR1001, 1002	48-83654H01	DIODE, silicon
P1000		CONNECTOR, plug: includes 15-83498F06 HOUSING, connector; 29-83499F01 CONTACT, connector; 5 req'd. and 46-84549F01 PLUG, polarizing
W1001	1-80775B21	CABLE ASSEMBLY: includes reference item P1000; 42-10217A02 STRAP, cable; 4 req'd. and miscellaneous wire leads

TONE "PRIVATE-LINE" ENCODER

MODEL TLN5731A

TECHNICAL CHARACTERISTICS

"PL" TONE FREQUENCY	Selected from 67-210 Hz range
FREQUENCY DETERMINING DEVICE	"Vibrasender" Resonant Reed
STABILITY	±0.15%
LEVEL (nominal)	350 mV rms
OUTPUT IMPEDANCE	4.7k ohms
POWER REQUIREMENTS	+9.6 V dc @15 mA

1. DESCRIPTION

The "Private-Line" (PL) encoder generates a low-frequency audio tone for continuous modulation of the transmitted rf signal in "Private-Line" operation.

NOTE

The tone signal is used only to unsquelch receivers in specific networks and is not heard.

2. FUNCTIONAL OPERATION

2.1 GENERAL

The encoder may be divided into three major sections.

Tone Oscillator - The tone oscillator generates two equal-amplitude tone signals 180° out-of-phase whenever power is applied to the radio. A feedback amplifier provides negative feedback to limit the level of oscillation. The "Vibrasender" resonant reed determines the frequency of operation.

Reverse Burst Timing Generator - The reverse burst timing generator provides a transmitter turn-off delay of approximately 150 milliseconds after the transmitter is unkeyed. During this period, a shifted phase tone (reverse burst) is developed in the tone output circuit which dampens the oscillations of the "Vibrasponder" resonant reed in listening receivers to eliminate the "squelch tail" noise burst at the end of the message.

Tone Output Circuit - The tone output circuit provides a fixed level tone output to the modulator of the transmitter and shifts the phase of the tone during the reverse burst period to rapidly dampen the "Vibrasponder" resonant reeds in listening receivers.

2.2 TONE OSCILLATOR

The tone oscillator operates continuously while the station is "on". The outputs of the differential amplifier, formed by Q701 and Q702, are identical but 180° out of phase. The amplitudes of these collector signals are independent of frequency. A positive feedback signal is coupled through C701 and R708 to sustain oscillation. In addition, Model TLN4293B has a rapid turn-on circuit. When the radio is turned on, C710 begins to charge through R728 which biases Q710 on through R727. To quickly bring the tone output up to full output, Q710 acts as a shunt around R708, which increases the positive feedback. After approximately 1.5 seconds (voltage across C710 reaches 9.0 volts) Q710 turns off and has no further effect on circuit operation. The output of Q701 is applied to feedback amplifier Q708 through C704 and R712. When the signal level exceeds a fixed amount, Q708 is biased into operation. It provides a negative feedback signal which keeps the oscillator out of limiting, thus providing a sinusoidal wave output. The "Vibrasender" resonant reed is the frequency determining device of the oscillator. It acts as a very high Q, narrow bandpass transformer, coupling only its resonant frequency and blocking all others. At its resonant frequency, the reed vibrates to couple energy from the primary to the secondary winding.

2.3 REVERSE BURST TIMING CIRCUIT

In the unkeyed transmitter condition, delay generator, Q706, is forward biased through CR703 and R719 to A- placing A+ across R721. This voltage is coupled to the base of the delayed turn-off switch (Q707) by R722, and Q707 is biased "off".

When the PTT button is closed, keyed filtered A+ is applied to R716 and turns on the keying switch, Q705. With Q705 acting as a short circuit:

--Q707 is biased "on" through R723, CR702 and Q705 to A-.

--Keyed, filtered A+ is applied through Q707 to turn on the transmitter.

--C708 charges from the filtered A+ line through Q706 base-emitter junction, CR730 and R718.

--The PL switch gate, Q709, is turned on by bias current through R726 and Q705. This action turns off PL tone gate, Q703.

Note that Q706 has not changed states and is still turned on by bias current through R719.

When the PTT button is released, the keyed, filtered A+ bias is removed from Q705 and it turns off. The transmitter continues to receive A+ from Q707 during the following sequence of events; with Q705 turned off:

--The PL switch gate, Q709, is turned off, activating the PL tone gate, Q703, which passes the reverse burst tone signal.

--C708 discharges through R718, R719, R721, R722 and R723, back biasing CR703 and turning off Q706.

--With Q706 off, Q707 remains on by receiving base bias through R722 and R721.

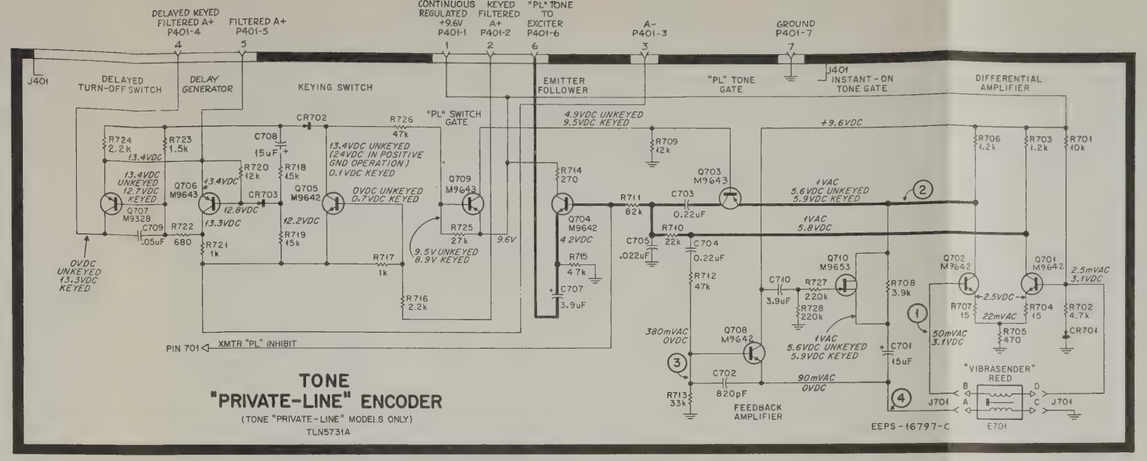
--After approximately 150 milliseconds, the voltage across C708 decreases to the point where Q706 turns on again and applies A+ across R721.

--The A+ across R721 turns off Q707 which removes the delayed keyed filtered A+ from the transmitter.

2.4 TONE OUTPUT CIRCUIT

When the transmitter is keyed, PL gate switch Q709 is turned on. Q709, in turn, gates 9.6 volts to PL tone gate Q703, turning it off. When Q703 is turned off, only the output of Q701 is coupled to emitter follower Q704. When the transmitter is unkeyed, Q709 is turned off and Q703 is turned on which completes the tone path from Q702 to C703. The two tone signals 180° out of phase, combine through the phase shift capacitors to produce a signal to the emitter follower that is 240° out of phase with the original tone. Emitter follower Q704 provides impedance matching in a low impedance output and isolates the tone oscillator from the external circuit to which the tone output is applied.

EPS-17757-A



TONE "PRIVATE-LINE" ENCODER

(TONE "PRIVATE-LINE" MODELS ONLY)

TLN5731A

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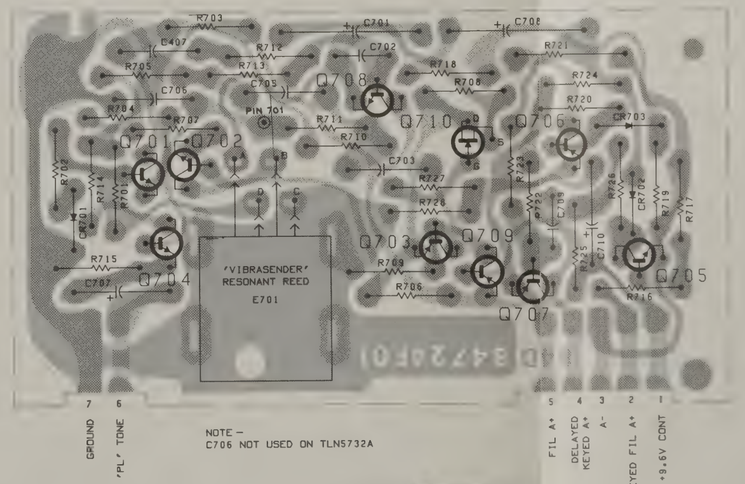

NOTE – C706 NOT USED ON TLN5732A

SOLDER SIDE
COMPONENT SIDE BD-CEPS-16799-0 OL-CEPS-16810-A

"PL" ENCODER

701. ALL AC VOLTAGE MEASUREMENTS ARE RMS VALUES. ALL AC VOLTAGES ARE SINUSOIDAL EXCEPT Q708 EMITTER. METER READING DEPENDENT UPON METER RESPONSE TO NON-SINUSOIDAL WAVE.

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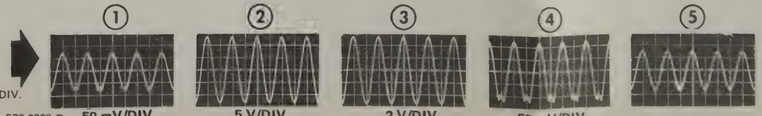
704. PIN 701 IS USED ONLY FOR CERTAIN OPTIONAL EQUIPMENT.

EPS-7051-A

"PL" ENCODER WAVEFORMS

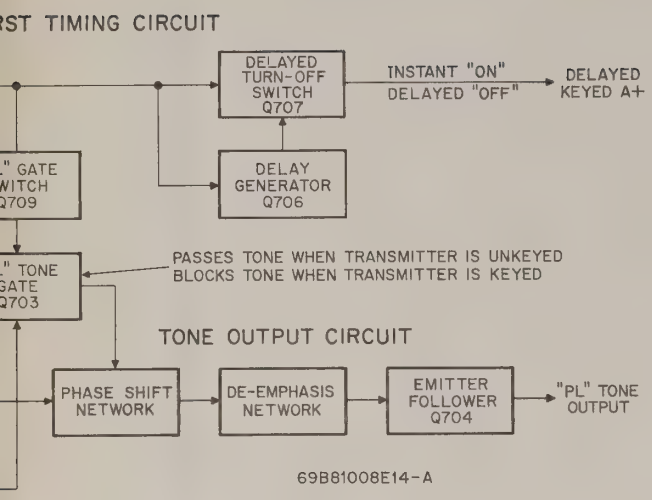
OSCILLOSCOPE WAVEFORMS MEASURED UNDER FOLLOWING CONDITIONS:

1. WAVEFORMS SHOWN USING 100-Hz "VIBRASENDER" RESONANT REED.
2. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
3. HORIZONTAL DEFLECTION = 5 msec/DIV.
4. ALL WAVEFORMS MEASURED IN RESPECT TO CHASSIS GROUND.



EPS-6260-B

68P81026E71-E
1/4/77-UP



(d) If no signal is present any component in the oscillator loop could cause the trouble. Check the "Vibrasender" resonant reed in the SLN6221A "Private-Line" Tone Generator.

(e) If the tone generator does not produce an output signal the reed is defective.

(f) If the reed is good, replace it in the encoder and make dc voltage measurements in the tone oscillator circuit to locate the defective component.

(2) If low deviation is measured, check ac signal voltages and compare them with the chart readings to find the source of trouble.

(3) If deviation is normal, but calls are not being received, check the frequency of the PL encoder tone. If off-frequency, replace the "Vibrasender" resonant reed.

(4) If squelch tail noise bursts are heard by all listening receivers, check dc voltages of Q703 and Q706 in keyed and unkeyed conditions.

(5) If the transmitter cannot be keyed, and the trouble has been isolated to the PL encoder board, measure dc voltages in Q705 and Q707 stages.

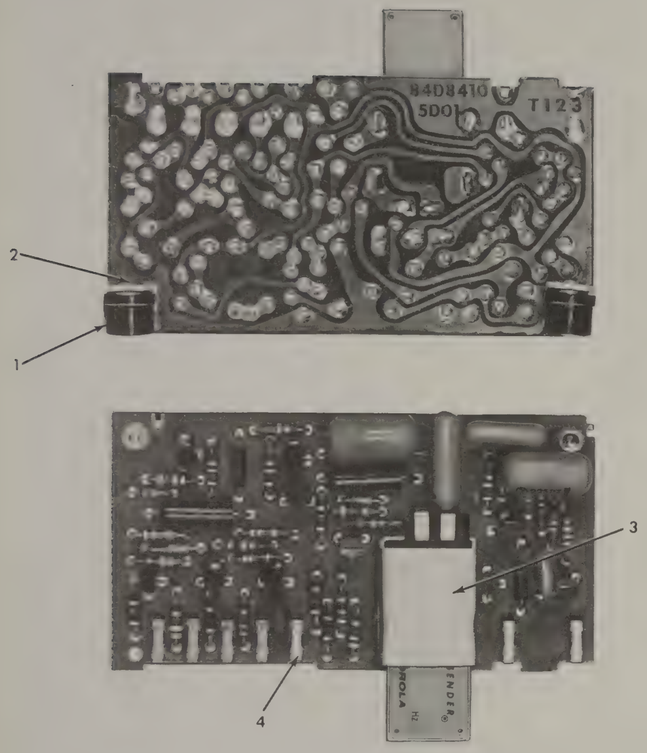
(6) If too much tone deviation is measured, check feedback amplifier Q708.

tations with Simplex "Digital Private-Line" Binary-Coded Squelch.

code word generator (located on "Digital Private-Line" Decoder Board) to the exciter,
w pass active filter for 23-bit binary code word.
delayed keyed A+ (180 millisecond transmitter turn-off delay.

"DIGITAL PRIVATE-LINE" ENCODER BOARD TROUBLESHOOTING CHART

	PROBABLE CAUSES	ACTION
l A+	1. No keyed A+ to encoder board (pin 2).	Check keyed A+ at pin 10 of P902 on exciter board
	2. Malfunction in delayed keyed A+ generation circuitry.	Check delayed turn-off switch, delay generator and keying switch operation on encoder board.
+ s than er than nkeying.	Malfunction in delayed keyed A+ circuits.	Check C710. Then check delay generator circuit.
it code out r unkeyed.	1. No input to encoder board pin 6 from decoder board.	On decoder board, check U801-5 for code signal. Check for 6.0 V dc at U801-24. If 6.0 V dc is present, check 50 kHz clock for proper operation (U801-4). If clock is ok, replace U801.
	2. Faulty inverter (Q702)	Check inverter operation.
	3. Active filter malfunction	Check Q703, Q704 operation.
ff code) ard pin 10 s unkeyed.	U801 code generator on decoder board is not switching.	On decoder board, ground U801-9. If code is still present at U801-5, check 50 kHz clock output (U801-4). If clock is ok, replace U801.
ot code) is l pin 10 when d.	U801 code generator on decoder board is not switching.	Apply +9.6 V at J805 on decoder board. If turn-off code is still present at U801-5, replace U801.
sound" ker of this	1. Code deviation is greater than ±1 kHz	Check for proper waveform amplitude at encoder board pin 10 (Xmit code out).
	2. Low pass active filter is not switching from 140 Hz to 85 Hz.	Replace Q705.
heard a radio transmitter.	1. No turn-off code is being transmitted.	Check the delayed keyed A+ duration (170-250 msec). Then check U801-5 on decoder board for presence of the turn-off code.
	2. Low pass active filter is always switched low (85 Hz).	Replace Q705.
in the led by this e is being	Wrong code is being transmitted.	Feed U801-5 from decoder board into a Motorola Model SLN6413A "Digital Private-Line" test set. Check for proper decode. If proper decode is not obtained. Check for an intermittent or bad code plug (TRN6005A) or resistor network (Z801) on the decoder board. Check U801-15 thru U801-23 for a proper octal code.



AEPS-6945-O

MECHANICAL PARTS LIST

TLN5731A and TLN4293B
"Private-Line" Encoder PL-1308-D

CODE	MOTOROLA PART NO.	DESCRIPTION
1	42-84284B01	RETAINER, screw: 2 req'd
2	3-138162	LOCKSCREW, tapping: No 4 x 3/8" Phillips hex head; 2 req'd
3	42-84116B02	SOCKET & BRACKET ASSEMBLY: for "Vibrasender" Resonant Reed
4	9-83011H01	TERMINAL, pin: female 7 req'd

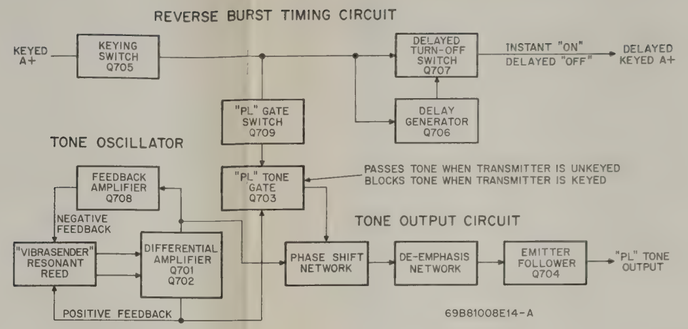
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

ELECTRICAL PARTS LIST

TLN5731A Tone "Private-Line" Encoder PL-3260-C

		CAPACITOR, fixed: uF; ±10%; 50 V; unless otherwise stated
C701	23-84762H09	15 ±20%; 20 V
C702	21-82187B23	820 pF; 500 V
C703, 704	8-82905G32	0.22
C705	8-83813H08	.022
C706		NOT USED
C707	23-84762H08	3.9 uF ±20%; 15 V
C708	23-83214C26	15; 25 V
C709	21-82372C04	.05; +80-20%; 25 V
C710	23-84762H08	3.9 uF ±20%; 15 V
		DIODE: (SEE NOTE I)
CR701, 702, 703	48-83654H01	silicon
		CONNECTOR, receptacle:
J401		consists of 7 female contact terminals (Part No. 9-83011H01) mounted on edge of circuit board
		"VIBRASENDER" RESONANT REED: (SEE NOTE II)
E701	TLN6824A	"plug-in" unit
		TRANSISTOR: (SEE NOTE I)
Q701, 702	48-869570	NPN; type M9570
	or 48-869642	NPN; type M9642
Q703	48-869571	PNP; type M9571
	or 48-869643	PNP; type M9643
Q704, 705	48-869570	NPN; type M9570
	or 48-869642	NPN; type M9642
Q706	48-869571	PNP; type M9571
	or 48-869643	PNP; type M9643
Q707	48-869328	PNP; type M9328
Q708	48-869570	NPN; type M9570
	or 48-869642	NPN; type M9642
Q709	48-869571	PNP; type M9571
	or 48-869643	PNP; type M9643
Q710	48-869653	FET; type M9653
		RESISTOR, fixed: ±5%; 1/4 W; unless otherwise stated
R701	6-124A73	10k
R702	6-124A65	4.7k
R703, 706	6-124A51	1.2k
R704	6-124A05	15
R705	6-124A41	470
R707	6-124A05	15
R708	6-124A63	3.9k
R709	6-124C75	12k ±10%
R710	6-124A81	22k
R711	6-124A95	82k
R712	6-124A89	47k
R713	6-124A85	33k
R714	6-124C35	270 ±10%
R715	6-124A65	4.7k
R716	6-124C57	2.2k ±10%
R717	6-124C49	1k ±10%
R718	6-124A53	1.5k
R719	6-124A77	15k
R720	6-124A75	12k
R721	6-125A49	1k
R722	6-124A45	680
R723	6-124A53	1.5k
R724	6-124C57	2.2k ±10%
R725	6-124C83	27k ±10%
R726	6-124C89	47k ±10%
R727, 728	6-124D06	220k ±10%

NOTES:



MAINTENANCE

a. Recommended Test Equipment

(1) Motorola SLN6221A "Private-Line" Tone Generator -- used for testing "Vibrasender" resonant reeds.

(2) Motorola Solid-State AC Voltmeter -- used for tone level measurement.

(3) General purpose oscilloscope -- valuable for signal tracing and locating sources of distortion.

(4) Motorola Solid-State DC Multimeter -- used for dc voltage measurement.

(5) Motorola S1343 Series Frequency Counter or S1344 Series Frequency Counter/Deviation Meter -- used for measuring PL tone frequency.

b. Performance Test

Measure frequency deviation of the transmitter in which the PL encoder is installed. With the transmitter keyed and PL tone modulation (only), deviation should read ±0.5 to ±1.0 kHz.

c. Troubleshooting

(1) If no deviation is measured the trouble may lie in the tone oscillator or tone output circuit. The trouble may be isolated by the following steps.

(a) Check 9.6-volt input to encoder.

(b) Check ac signal voltage at collector of Q701.

(c) If signal is present, check Q704.

(d) If no signal is present any component in the oscillator loop could cause the trouble. Check the "Vibrasender" resonant reed in the SLN6221A "Private-Line" Tone Generator.

(e) If the tone generator does not produce an output signal the reed is defective.

(f) If the reed is good, replace it in the encoder and make dc voltage measurements in the tone oscillator circuit to locate the defective component.

(2) If low deviation is measured, check ac signal voltages and compare them with the chart readings to find the source of trouble.

(3) If deviation is normal, but calls are not being received, check the frequency of the PL encoder tone. If off-frequency, replace the "Vibrasender" resonant reed.

(4) If squelch tail noise bursts are heard by all listening receivers, check dc voltages of Q703 and Q706 in keyed and unkeyed conditions.

(5) If the transmitter cannot be keyed, and the trouble has been isolated to the PL encoder board, measure dc voltages in Q705 and Q707 stages.

(6) If too much tone deviation is measured, check feedback amplifier Q708.

SIMPLEX "DIGITAL PRIVATE-LINE" ENCODER

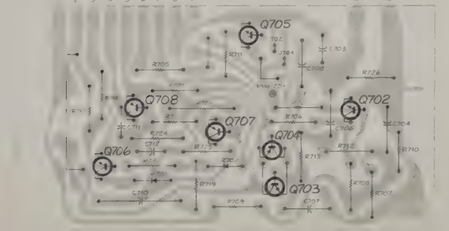
MODEL TTN6003A

PARTS LIST

TTN6003A Encoder Board

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
		CAPACITOR - (SEE NOTE)
		100 pF ±10
		.05 +80-20%; 25 V
		.001 ±10%; 100 V
CR701, 702	48-836541N01	DIODE: (SEE NOTE) silicon
Q702, 703	48-866442	SISTOR (SEE NOTE)
	48-866442A1	NPN: type M9642
	48-869842	NPN: type M9642
	48-869843	PNP: type M9643
	48-869328	PNP: type M9328
R705	6-124A75	RESISTOR, fixed: ±5%; 1/4 W; unless otherwise stated 12k
R706	6-124A81	22k
R707, 708	6-124A97	100k
R709	6-124A93	68k
R710	6-124A96	91k
R711	6-124A75	10k
		100k
		2k ±10%
		1k ±10%
		1.5k
		15k
		2k
R721	6-124A49	1k
R724	6-124A53	1.5k
R725	6-124C57	2.2k ±10%
R726	6-124A73	10k
R727	6-124A91	56k

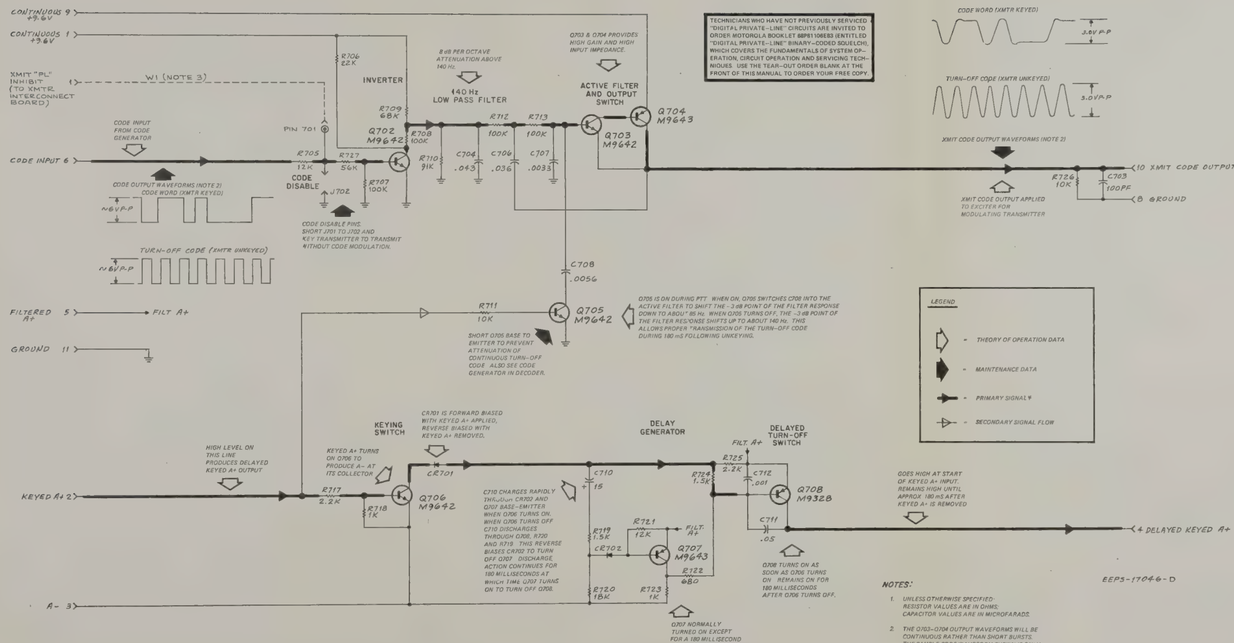
For optimum performance, diodes, transistors and integrated circuits must be ordered by Motorola part numbers.



SHOWN FROM SOLDER SIDE

SOLDER SIDE

OLCEPS-17054-B


CONTINUOUS 9 +8.6V
CONTINUOUS 1 +36V
XMIT "PL" INHIBIT (TO XMTR INTERCONNECT BOARD)
W1 (NOTE 3)
CODE INPUT FROM CODE GENERATOR
CODE INPUT 6
CODE OUTPUT WAVEFORMS (NOTE 2) CODE WORD (XMTR KEYED)
.6V P-P
TURN-OFF CODE (XMTR UNKEYED)
FILTERED AF
FILT A+
GROUND 11
PIN 701
CODE DISABLE
J702
CODE DISABLE PINS: SHORT J701 TO J702 AND KEY TRANSMITTER TO TRANSMIT WITHOUT CODE MODULATION.
INVERTER
Q702 M9643
8 dB PER OCTAVE ATTENUATION ABOVE 140 Hz
140 Hz LOW PASS FILTER
Q703 & Q704 PROVIDES HIGH GAIN AND HIGH INPUT IMPEDANCE.
ACTIVE FILTER AND OUTPUT SWITCH
Q704 M9643
Q703 M9642
R706 22K
R708 100K
R709 68K
R710 91K
R717 100K
R713 100K
C704 .043
C706 .036
C707 .0033
C708 .0056
R711 10K
Q705 M9642
SHORT Q705 BASE TO EMITTER TO PREVENT ATTENUATION OF CONTINUOUS TURN-OFF CODE. ALSO SEE CODE GENERATOR IN DECODER.
Q705 IS ON DURING PTT. WHEN ON, Q705 SWITCHES C708 INTO THE ACTIVE FILTER TO SHIFT THE -3 dB POINT OF THE FILTER RESPONSE DOWN TO ABOUT 85 Hz. WHEN Q705 TURNS OFF, THE -3 dB POINT OF THE FILTER RESPONSE SHIFTS UP TO ABOUT 140 Hz. THIS ALLOWS PROPER TRANSMISSION OF THE TURN-OFF CODE DURING 180 mS FOLLOWING UNKEYING.
TECHNICIANS WHO HAVE NOT PREVIOUSLY SERVICED "DIGITAL PRIVATE-LINE" CIRCUITS ARE INVITED TO ORDER MOTOROLA BOOKLET 68P81106E83 (ENTITLED "DIGITAL PRIVATE-LINE" BINARY-CODED SQUELCH), WHICH COVERS THE FUNDAMENTALS OF SYSTEM OPERATION, CIRCUIT OPERATION AND SERVICING TECHNIQUES. USE THE YEAR-OUT ORDER BLANK AT THE FRONT OF THIS MANUAL TO ORDER YOUR FREE COPY.
CODE WORD (XMTR KEYED)
3.6V P-P
TURN-OFF CODE (XMTR UNKEYED)
3.0V P-P
XMIT CODE OUTPUT WAVEFORMS (NOTE 2)
XMIT CODE OUTPUT APPLIED TO EXCITER FOR MODULATING TRANSMITTER
R726 10K
C703 100PF
10 XMIT CODE OUTPUT
8 GROUND
LEGEND
= THEORY OF OPERATION DATA
= MAINTENANCE DATA
= PRIMARY SIGNAL
= SECONDARY SIGNAL FLOW
KEYING SWITCH
CR701 IS FORWARD BIASED WITH KEYED A+ APPLIED, REVERSE BIASED WITH KEYED A+ REMOVED.
HIGH LEVEL ON THIS LINE PRODUCES DELAYED KEYED A+ OUTPUT.
KEYED A+ TURNS ON Q706 TO PRODUCE A- AT ITS COLLECTOR.
KEYED A+ 2
A- 3
CR701
R717 2.2K
R718 1K
Q706 M9642
C710 .15
C710 CHARGES RAPIDLY THROUGH CR702 AND Q707 BASE-EMITTER WHEN Q706 TURNS ON. WHEN Q706 TURNS OFF C710 DISCHARGES THROUGH D708, R720 AND R719. THIS REVERSE BIASES CR702 TO TURN OFF Q707. DISCHARGE ACTION CONTINUES FOR 180 MILLISECONDS AT WHICH TIME Q707 TURNS ON TO TURN OFF Q708.
DELAY GENERATOR
R719 1.5K
CR702
R720 18K
R721 12K
Q707 M9643
R722 680
R723 1K
FILT A+
CR707 NORMALLY TURNED ON EXCEPT FOR A 180 MILLISECOND PERIOD AFTER UNKEYING. WHEN TURNED ON COLLECTOR VOLTAGE HOLDS Q708 OFF PROVIDING Q708 IS TURNED OFF.
DELAYED TURN-OFF SWITCH
R725 2.2K
R724 1.5K
C712 .001
Q708 M9328
C711 .05
GOES HIGH AT START OF KEYED A+ INPUT, REMAINS HIGH UNTIL APPROX 180 mS AFTER KEYED A- IS REMOVED
Q708 TURNS ON AS SOON AS Q706 TURNS ON. REMAINS ON FOR 180 MILLISECONDS AFTER Q706 TURNS OFF.
+ DELAYED KEYED A+
EEPS-17046-D

NOTES:

1. UNLESS OTHERWISE SPECIFIED: RESISTOR VALUES ARE IN OHMS; CAPACITOR VALUES ARE IN MICROFARADS.
2. THE Q703-Q704 OUTPUT WAVEFORMS WILL BE CONTINUOUS RATHER THAN SHORT BURSTS. THE SAMPLE CODE WAVEFORM SHOWN IS ONLY A SMALL PORTION OF THE OVERALL.
3. CABLE W1 IS PART OF PAGING OPTION.

APPLICATION

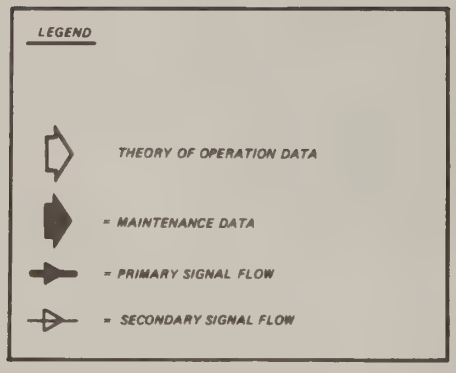
"Micor" Base Stations with Simplex "Digital Private-Line" Binary-Coded Squelch.

FUNCTION

1. Interfaces code word generator (located on "Digital Private-Line" Decoder Board) to the exciter, provides low pass active filter for 23-bit binary code word.
2. Generates delayed keyed A+ (180 millisecond transmitter turn-off delay).

"DIGITAL PRIVATE-LINE" ENCODER BOARD TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSES	ACTION
No delayed keyed A+ to exciter board.	1. No keyed A+ to encoder board (pin 2).	Check keyed A+ at pin 10 of P902 on exciter board
	2. Malfunction in delayed keyed A+ generation circuitry.	Check delayed turn-off switch, delay generator and keying switch operation on encoder board.
Delayed keyed A+ remains high less than 160 msec or longer than 220 msec after unkeying.	Malfunction in delayed keyed A+ circuits.	Check C710. Then check delay generator circuit.
No Output on Xmit code out (pin 10), keyed or unkeyed.	1. No input to encoder board pin 6 from decoder board.	On decoder board, check U801-5 for code signal. Check for 6.0 V dc at U801-24. If 6.0 V dc is present, check 50 kHz clock for proper operation (U801-4). If clock is ok, replace U801.
	2. Faulty inverter (Q702)	Check inverter operation.
	3. Active filter malfunction	Check Q703, Q704 operation.
Code (not turn-off code) is on encoder board pin 10 when the radio is unkeyed.	U801 code generator on decoder board is not switching.	On decoder board, ground U801-5. If code is still present at U801-5, check 50 kHz clock output (U801-4). If clock is ok, replace U801.
Turn-off code (not code) is on encoder board pin 10 when the radio is keyed.	U801 code generator on decoder board is not switching.	Apply +9.6 V at J805 on decoder board. If turn-off code is still present at U801-5, replace U801.
Excessive "code sound" heard at the speaker of radio listening to this transmitter.	1. Code deviation is greater than ±1 kHz	Check for proper waveform amplitude at encoder board pin 10 (Xmit code out).
	2. Low pass active filter is not switching from 140 Hz to 85 Hz.	Replace Q705.
Squelch tails are heard at the speaker of a radio listening to this transmitter.	1. No turn-off code is being transmitted.	Check the delayed keyed A+ duration (170-250 msec). Then check U801-5 on decoder board for presence of the turn-off code.
	2. Low pass active filter is always switched low (85 Hz).	Replace Q705.
No other radios in the system are enabled by this transmitter; code is being transmitted.	Wrong code is being transmitted.	Feed U801-5 from decoder board into a Motorola Model SLN6413A "Digital Private-Line" test set. Check for proper decode. If proper decode is not obtained. Check for an intermittent or bad code plug (TTRN6005A1 or resistor network (Z801) on the decoder board. Check U801-15 thru U801-23 for a proper octal code.



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PARTS LIST

TLN5725A Encoder Board. PL-3300-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF;
C701	21-82610C58	100 pF ±10%; 100 V
C702	21-82133G24	20 pF ±5%; 500 V
C703	21-82428B09	.0047 ±10%; 100 V
C704, 709	21-82187B22	270 pF ±10%; 200 V
C705	8-83813H14	.043 ±5%; 50 V
C706	8-83813H24	.036 ±5%; 50 V
C707	8-83813H27	.0033 ±5%; 50 V
C710	23-82783B24	15 ±10%; 25 V
C711	21-82372C04	.05 ±10%; 25 V
		DIODE: (SEE NOTE)
CR701, 702	48-83654H01	silicon
		TRANSISTOR: (SEE NOTE)
Q701	48-869652	field-effect; M9652
Q702, 703, 705, 706	48-869642	NPN; type M9642
Q704, 707	48-869643	PNP; type M9643
Q708	48-869328	PNP; type M9328
		RESISTOR, fixed: ±5%; 1/4 W; unless otherwise stated
R701, 704	6-124D14	470k ±10%
R702	6-124C77	15k ±10%
R703	6-124D04	180k ±10%
R705	6-124A83	27k
R706	6-124B02	150k
R707	6-124C85	33k ±10%
R708	6-124A79	18k
R709, 711	6-124C81	22k ±10%
R710, 717	6-124A89	47k
R712, 713	6-124A97	100k
R714	6-124A73	10k
R715	6-124C97	100k ±10%
R716	6-124C73	10k ±10%
R718	6-124C37	330 ±10%
		INTEGRATED CIRCUIT: (SEE NOTE)
U701	51-84267A82	type M6782
		VOLTAGE REGULATOR:
VR701	48-83696F07	Zener; 6.2 V
		CRYSTAL:
Y701	48-82003K01	resonator; 50.000 KC
		RESISTOR NETWORK:
Z701	1-80772B36 or 51-82142K02	pull-up, 10-pin
Z702	1-80772B35 or 51-82142K01	push-to-talk, 10-pin

NOTE: For optimum performance, diodes, transistors and integrated circuits must be ordered by Motorola part numbers.

TAB 1. DESCRIPTION

TAB 2. INSTALLATION

TAB 3. STATION MAINT
POWER SUPPLY

STATION MAINTENANCE
MAINTENANCE LOG SHEET
METERING & INTERCOM
POWER SUPPLY

TAB 4. TRANSMITTER

ALIGNMENT
MAINTENANCE
INTERCONNECT BOARD
EXCITER/1ST BANDPASS FILTER
POWER AMPLIFIERS
POWER CONTROL BOARD/
ANTENNA NETWORK/CONTROL STAGE
"PRIVATE–LINE" ENCODERS

TAB 5. RECEIVER

ALIGNMENT
MAINTENANCE
INTERCONNECT BOARD
RF & IF
AUDIO & SQUELCH
"PRIVATE–LINE" DECODERS

DUPLEX "DIGITAL PRIVATE-LINE" ENCODER

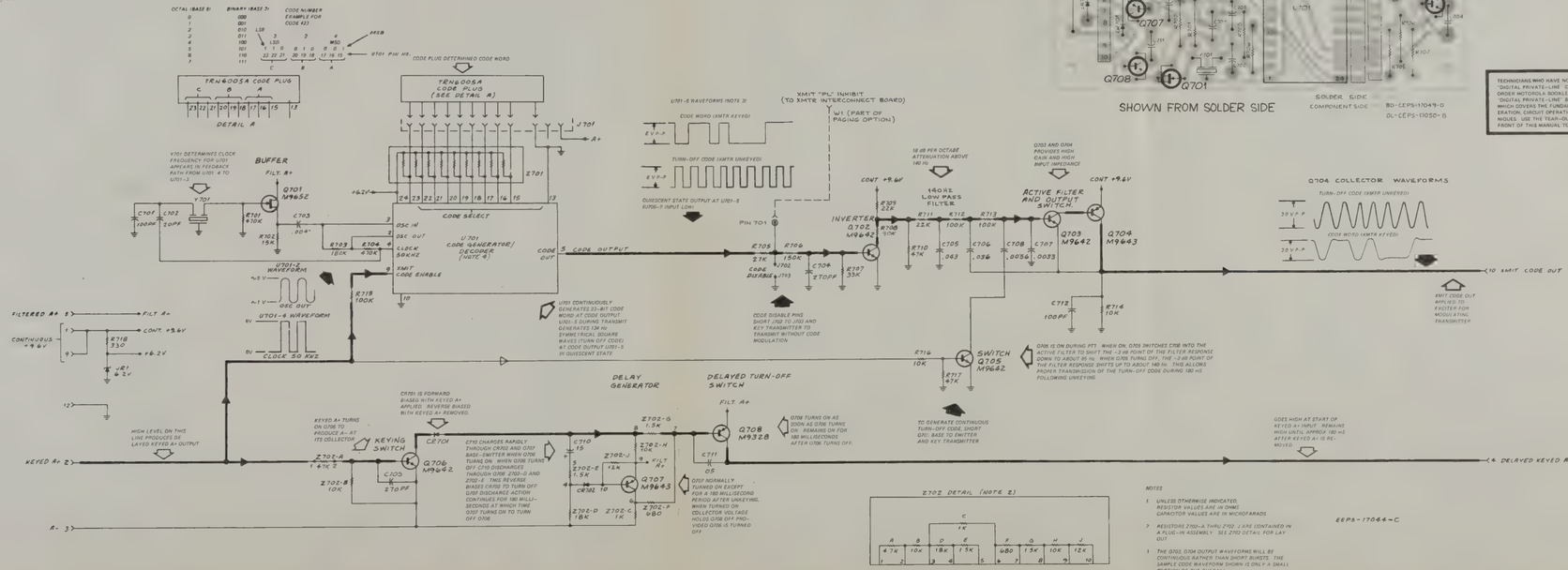
MODEL TLN5725A

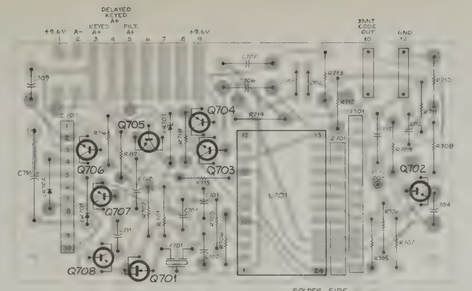
APPLICATION --

Micor® Base Stations & Repeaters

FUNCTION --

Generates "Digital Private-Line" Code for transmitter in duplex applications (where decoder and encoder may be on simultaneously). Develops 180 mS transmitter turn-off delay (delayed keyed A+).





80-CEPS-11049-O
DL-CEPS-11050-B

TECHNICIANS WHO HAVE NOT PREVIOUSLY SERVICED "DIGITAL PRIVATE-LINE" CIRCUITS ARE INVITED TO ORDER MOTOROLA BOOKLET (68P81098E82 (ENTITLED "DIGITAL PRIVATE-LINE" BINARY CODES SQUELCH) WHICH COVERS THE FUNDAMENTALS OF SYSTEM OPERATION, CIRCUIT OPERATION AND SERVICING TECHNIQUES. USE THE TEAR-OUT ORDER BLANK AT THE FRONT OF THIS MANUAL TO ORDER YOUR FREE COPY

LEGEND

- THEORY OF OPERATION DATA
- MAINTENANCE DATA
- PRIMARY SIGNAL FLOW
- SECONDARY SIGNAL FLOW

PARTS LIST

TLN5725A Encoder

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TAB 1. DESCRIPTION

TAB 2. INSTALLATION

TAB 3. STATION MAINT
POWER SUPPLY

STATION MAINTENANCE
MAINTENANCE LOG SHEET
METERING & INTERCOM
POWER SUPPLY

TAB 4. TRANSMITTER

ALIGNMENT
MAINTENANCE
INTERCONNECT BOARD
EXCITER/1ST BANDPASS FILTER
POWER AMPLIFIERS
POWER CONTROL BOARD/
ANTENNA NETWORK/CONTROL STAGE
"PRIVATE–LINE" ENCODERS

TAB 5. RECEIVER

ALIGNMENT
MAINTENANCE
INTERCONNECT BOARD
RF & IF
AUDIO & SQUELCH
"PRIVATE–LINE" DECODERS

ALIGNMENT

1. TWO-RECEIVER STATIONS

The two-receiver coupler (TLE8340A) used to connect both receivers to an antenna does not require alignment. Align both receivers while disconnected from the two-receiver coupler. Inject signal generator output into each receiver at the rf preselector (or preamp) and align. Then re-connect the two-receiver coupler and check for proper operation. There will be a 3.5-4.0 dB loss in the coupler and a 6 dB gain through the preamplifier.

2. FREQUENCY CALCULATIONS

$f_c = 24\, f_o + 11.7$ MHz or $f_c = 24\, f_o + 11.8$ MHz

$$f_o = \frac{f_c - 11.7 \text{ MHz}}{24} \quad \text{or} \quad f_o = \frac{f_c - 11.8 \text{ MHz}}{24}$$

Where: f_c = carrier frequency
f_o = channel element frequency
11.7 MHz = mixer output frequency (i-f)
11.8 MHz = mixer output frequency (i-f shifted)
24 = channel element harmonic

The receiver i-f is factory shifted from 11.7 MHz to 11.8 MHz when the difference between received carrier (channel spacing) frequencies is:

11.7 MHz ±25 kHz
5.85 MHz ±25 kHz
3.90 MHz ±25 kHz
2.925 MHz ±25 kHz

3. TUNE-UP FREQUENCY SELECTION FOR MULTI-FREQUENCY STATIONS

3.1 Maximum frequency separation up to .5 MHz - Set the frequency selector switch to the frequency closest to the center of the range covered. For two-frequency radios select the higher frequency.

3.2 Maximum frequency separation between .5 MHz and 1.0 MHz - Remove one channel element and insert a tune-up element whose frequency is midway between the two most widely separated frequencies. Set the frequency selector switch to select this element.

MOTOROLA INC.
Communications Division

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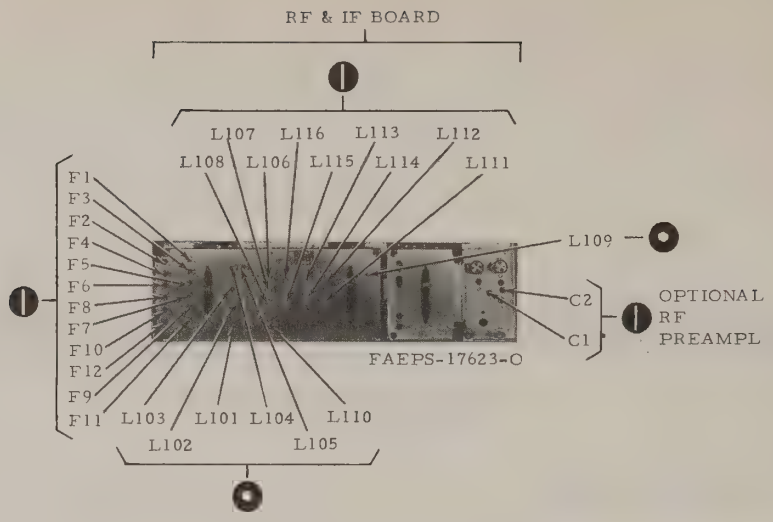
1301 E. Algonquin Road, Schaumburg, IL 60196



Receiver Adjustment Locations

4. RECEIVER ALIGNMENT (RF & IF BOARD)

NOTE:
This procedure includes optional rf preamplifier alignment details. If an optional rf preamplifier is not used, simply disregard preamplifier identified steps in the procedure.

STEP	ADJUSTMENT	METER POSITION	STAGE AND PROCEDURE
1	L101, L102, L103, L104, L105	-	Multiplier Coils - Adjust the cores of L101 through L105 to the end of the coil form away from the circuit board.
2	L106, L107, L108	-	Injection Filter - Adjust the tuning screws for L106 through L108 until the top of each tuning screw extends approximately one-eighth inch below the receiver shield.
3	L101, L102	1	Channel Element Output - Alternately tune L101 and L102 CCW two turns at a time until a peak indication on meter 1 is obtained.
4	L103, L104	2	First Doubler - Tune L103 CCW for a peak reading on meter 2. Tune L104 CCW for a dip on meter 2.
5	L105, L104	3	Second Doubler - Tune L105 CCW for a peak on meter 3. Tune L104 for a peak on meter 3. Repeak both coils until no further improvement can be obtained.
6	L101, L103	3	Detune L101 until meter 3 drops to 10 uA. Tune L103 for peak reading on meter 3, keeping this peak below 12 uA by further detuning of L101 if necessary.
7	L101, L102	1	Alternately tune L101 and L102 for peak reading on meter 1 until no further improvement can be obtained.
8	L106, L107, L108	3	Injection Filter - Tune L106 for a dip on meter 3. Tune L107 for a peak reading on meter 3. Tune L108 for a dip on meter 3. Do not repeat.
9	L109	4, 5	Discriminator - Insert 11.7 MHz injection probe of the test set into L110 hole on receiver shield. Be careful not to contact the circuit board. Set METER REV switch to position A or B for this step and be sure that the test set is equipped with an 11.7 MHz crystal in the corresponding A or B socket. Insert the injection probe far enough to obtain a saturated reading on meter 5. It should be possible to obtain readings on either side of zero (center) on meter 4 by tuning L109. Tune L109 for an EXACT zero reading on meter 4. This adjustment is critical.

STEP	ADJUSTMENT	METER POSITION	STAGE AND PROCEDURE
10	L110, L111, L112, L113, L114, L115, L116	4, 5	RF Preselector and Mixer - Unsquelch the receiver by turning the SQUELCH control fully counterclockwise. Disable the PL decoder by switching the PL monitor switch on the STATION CONTROL MODULE to the DISABLE position. Connect an rf signal generator to the receiver input connector and set the rf output of the generator to maximum. NOTE If the receiver frequency has been changed by more than 1 MHz, preset tuning screws L111 through L116 so that the screw end is in the space between the board and its shield, and approximately one-eighth inch from the shield. If the receiver is equipped with the optional preamplifier, disconnect and bypass the preamplifier. Set the generator to the carrier frequency by observing meters 4 and 5. NOTE If no indication is seen, unscrew the shell of the antenna cable connector, and pull the plug partially out of the jack so that the cable shield no longer makes contact with the station chassis. Set the generator to the carrier frequency as indicated by meter positions 4 and 5, then reconnect the cable shield to the radio. Adjust L111 through L116 clockwise one turn at a time, watching meter 5 for an increase in indication above noise level. Tune L111 through L116 for peak reading on meter 5, reducing generator output level as necessary to keep meter 5 out of saturation. Tune L110 for peak on meter 5. Repeat the adjust of L111 through L116. Turn L111 through L116 in or out as necessary until all screws are level. Repeat the adjustment of L111 through L116.
11	L106, L107, L108	11 (rcvr audio)	Tune L106, L107 and L108 for best noise quieting (minimum meter indication). Maximum meter 11 sensitivity may be obtained by placing the multiplier switch on the test set in the .2 V AC position.
12	L111, L112, L113, L114, L115, L116	11 (rcvr audio)	Tune L111 through L116 for best noise quieting. Repeat until no further improvement in quieting level can be obtained.
13	C1, C2, L111	5, 11	Preamplifier - If the receiver is equipped with the optional preamplifier, reconnect the preamplifier. Tune C1 and C2 for maximum meter 5 reading. Then tune C1, C2, and L111 for best noise quieting on meter 11.
14			Perform 20 dB quieting sensitivity measurement as check of alignment. Refer to the following Receiver Maintenance information which describes how to check 20 dB quieting sensitivity. The 20 dB quieting level should be less than .5 uV (.25 uV with preamplifier).

MAINTENANCE

1. RECEIVER RF AND IF BOARD

CAUTION

Do not remove the channel element by exerting force through the hole provided for access to the channel warp capacitor. Excessive pressure will damage the capacitor. A small access hole is provided adjacent to the one for channel warp. Use a tuning tool (Motorola Part No. 66D84387C01) to push out element.

1.1 INTRODUCTION

This section provides maintenance procedures for the receiver rf and i-f board. These procedures consist of tests which include metering measurements and testing and troubleshooting procedures that include integrated circuit checks.

NOTE

The receiver rf and i-f board must be installed in a receiver for testing to provide the necessary power, ground, control and signal connections. The board should always be secured in place with all mounting screws for operation and testing to provide a good rf ground to all stages of the receiver. The board may be installed in the station or a "Micor" mobile radio set for testing.

1.2 PERFORMANCE TESTS

Use the following tests to determine if the receiver rf and i-f board is operating properly. If either of the tests produces unsatisfactory results, refer to the receiver rf and i-f troubleshooting chart for a procedure to isolate the defective stage.

1.2.1 No-Signal Meter Reading Check

1.2.1.1 General

1.2.1.1.1 A failure in almost any part of the rf and i-f board will result in an improper meter reading in one or more of the test positions. Improper alignment will also cause improper meter readings.

1.2.1.1.2 Compare the current readings observed in positions 1 through 5 with those in the following table. A low reading on meter position 1 indicates a defective channel element. A low reading on meter positions 2 or 3 indicates a defective multiplier circuit. Improper meter 4 or 5 readings indicate a malfunction elsewhere in the receiver; check rf and i-f voltages per the schematic diagram to isolate the malfunction.

MINIMUM RECEIVER RF & IF METER READINGS TABLE
(No Input Signal Applied)

SELECTOR SWITCH POSITION	READING (MICRO-AMPS)	CIRCUIT METERED
1	15	Channel element output
2	15	First Doubler output
3	15	Second Doubler output
4+, 4-	0 ±2	Discriminator output
5	10	Second i-f amplifier and limiter

1.2.1.2 Input Voltages

1.2.1.2.1 If there are no test set indications at one or more of the metered points, check the dc input voltages to the receiver rf and i-f circuit board.

P904-9	A+ continuous (+13.8 V dc with reference to chassis)
P904-11	9.6 V dc continuous (with reference to chassis) (±0.5 V)
P904-8	9.6 V dc continuous (with reference to chassis) (±0.5 V)

1.2.1.2.2 If test set indications localize the trouble to a specific stage or two, measure the dc input voltages to the suspected stages. Refer to the schematic diagram for the normal voltages.

1.2.1.3 Using the Portable Test Set

Step 1. The receiver rf and i-f board must be installed in a complete receiver for testing. Make sure the rf and i-f circuit board mounting screws are all secure and that all connections to the board are properly made.

Step 2. Be sure the receiver shield is in place.

Step 3. Apply ac input power to the station.

Step 4. Using a TEK-37 Adapter Cable, connect a Motorola portable test set or meter panel to the station as follows:

-- Connect the adapter cable 20-pin connector to the receptacle on the front of the test set or meter panel.

-- Connect the adapter cable 7-pin red "control" plug to the control receptacle on the unified chassis (J3).

-- Connect the adapter cable 7-pin white "metering" plug to the metering receptacle on the receiver rf and i-f board.

Step 5. Set the portable test set switches as follows:

-- Set the function switch to the RCVR position.

-- Set the meter reversing switch to the OFF position.

-- Set the adapter cable SENS switch to the 100 mV position. If the adapter cable has no SENS switch, the unit operates at 100 mV all of the time.

-- Set the adapter cable reference switch to position A or position B.

Step 6. Refer to the meter reading table in paragraph 1.2.1. Set the test set selector switch to the positions called for in the table and observe the test set meter. Notice that the meter readings given in the table are minimums.

1.2.1.4 Using Built-In Station Metering

Step 1. The receiver rf and i-f board must be installed in a complete receiver for testing. Make sure the rf and i-f circuit board mounting screws are all secure and that all connections to the board are properly made.

Step 2. Be sure the receiver shield is in place.

Step 3. Apply ac input power to the station.

Step 4. Connect the station metering kit "metering" plug to the metering receptacle on the receiver rf and i-f board.

Step 5. Refer to the meter reading table in paragraph 1.2.1. Set the meter selector switch to the positions called for in the table and observe the meter. Notice that the meter readings given in the table are minimums.

1.2.2 20 dB Quieting Sensitivity Test

This performance test may be used after repair and alignment to assure that the receiver meets all specifications before it is returned to service. The receiver shield must be in place while performing this test.

1.2.2.1 Using the Portable Test Set

Step 1. Set up the station and portable test set or meter panel as described in steps 1 through 5 of paragraph 1.2.1.3.

Step 2. Set the portable test set MULT switch to the 2 V AC position.

Step 3. Set the portable test set selector switch to position 11 (audio).

Step 4. Set the test set SPKR switch to the LOAD position and disconnect the station's speaker if you want to silence the station's speaker during the test.

Step 5. On "Private-Line" stations, disable PL by setting the PL slide switch on the STATION CONTROL MODULE in the DISABLE position.

Step 6. Set the receiver SQUELCH control fully counterclockwise (unsquelched).

Step 7. Adjust the receiver VOLUME control so the test set meter reads 2 volts AC.

Step 8. Connect an rf signal generator to the receiver input connector.

Step 9. Set the signal generator controls as follows:

-- Set up the signal generator to produce a CW or unmodulated signal.

-- Set the generator output level to maximum.

-- Set the signal generator output frequency to the selected channel receive frequency. To set the signal generator on frequency without a frequency counter, adjust the generator frequency control until test set meter position 4 reads exactly zero.

Step 10. With the portable test set selector switch in meter position 11 (audio), slowly decrease the

signal generator output level until the test set meter reads 0.2 volts AC (20 dB down from 2 volts AC). Move the portable test set MULT switch to the 0.2 V AC position if necessary.

NOTE

The output frequency of some signal generators will be "pulled" when the output level is near maximum. It may be necessary to reset the generator frequency to zero meter 4 as the output level is reduced.

Step 11. Note the signal generator output level. If the receiver rf and i-f board is functioning properly, this level should be 0.5 uV or less for a receiver without an rf preamplifier, or 0.25 uV or less for a receiver with an rf preamplifier.

1.2.2.2 Using Built-In Station Metering

NOTE

This section substitutes a separate AC voltmeter for the portable test set meter 11 position.

Step 1. The receiver rf and i-f board must be installed in a complete receiver for testing. Make sure the rf and i-f circuit board mounting screws are all secure and that all connections to the board are properly made.

Step 2. Be sure the receiver shield is in place.

Step 3. Apply ac input power to the station.

Step 4. Unsquelch the receiver by turning the SQUELCH control fully counterclockwise. "Private-Line" stations must also be PL disabled.

Step 5. Set the range switch on an ac voltmeter to the 2 V AC position and connect the voltmeter across the speaker terminals of the built-in station meter kit. Adjust the station VOLUME control for 2 volts as indicated on the voltmeter.

NOTE

The built-in station metering kit incorporates a DC voltmeter, not an AC voltmeter.

Step 6. Connect an rf signal generator to the receiver input connector.

Step 7. Set the signal generator controls as follows:

-- Set up the signal generator to produce a CW or unmodulated signal.

-- Set the generator output level to maximum.

-- Set the signal generator output frequency to the selected channel receive frequency. To set the signal generator on frequency without a frequency counter, adjust the generator frequency control until meter position 4 reads exactly zero.

Step 8. Slowly decrease the signal generator output level until the ac voltmeter reads 0.2 volts AC. Move the ac voltmeter switch to the 0.2 V AC position if necessary.

NOTE

The output frequency of some signal generators will be "pulled" when the output level is near maximum. It may be necessary to reset the generator frequency to zero meter 4 as the output level is reduced.

Step 9. Note the signal generator output level. If the receiver rf and i-f board is functioning properly, this level should be 0.5 uV or less for a receiver without an rf preamplifier, or 0.25 uV or less for a receiver with an rf preamplifier.

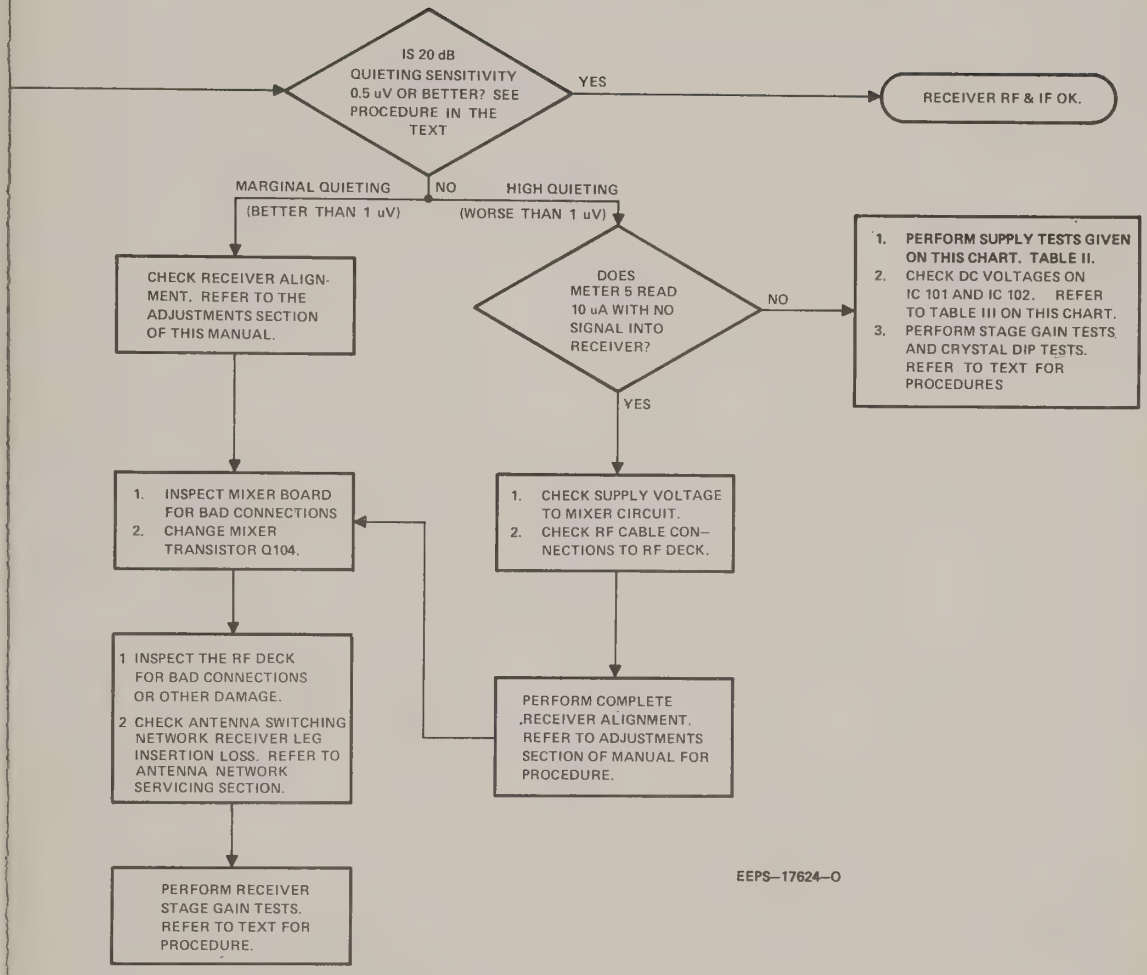
1.3 TROUBLESHOOTING

1.3.1 Visual Inspection

1.3.1.1 The first step in the troubleshooting procedure should be a thorough visual inspection of the receiver and, in particular, the receiver rf and i-f board. Corrosion and burned or damaged components are usually easily seen and may be the cause or a symptom of the receiver malfunction. Loose circuit board mounting screws, or a loose or improperly installed receiver shield are other easily found problems that can cause a considerable degradation in receiver performance.

1.3.1.2 After the "obvious" problems have been corrected, repeat the receiver rf and i-f board performance tests. If the tests still produce unsatisfactory results, refer to the receiver rf and i-f troubleshooting chart. The troubleshooting chart provides a systematic procedure for isolation of the defective stage and component.

1.3.1.3 As much information as possible has been included on the troubleshooting


IS 20 dB QUIETING SENSITIVITY 0.5 uV OR BETTER? SEE PROCEDURE IN THE TEXT
YES
RECEIVER RF & IF OK.
MARGINAL QUIETING (BETTER THAN 1 uV)
NO
HIGH QUIETING (WORSE THAN 1 uV)
CHECK RECEIVER ALIGNMENT. REFER TO THE ADJUSTMENTS SECTION OF THIS MANUAL.
DOES METER 5 READ 10 uA WITH NO SIGNAL INTO RECEIVER?
NO
1. PERFORM SUPPLY TESTS GIVEN ON THIS CHART. TABLE II.
2. CHECK DC VOLTAGES ON IC 101 AND IC 102. REFER TO TABLE III ON THIS CHART.
3. PERFORM STAGE GAIN TESTS AND CRYSTAL DIP TESTS. REFER TO TEXT FOR PROCEDURES
YES
1. INSPECT MIXER BOARD FOR BAD CONNECTIONS
2. CHANGE MIXER TRANSISTOR Q104.
1. CHECK SUPPLY VOLTAGE TO MIXER CIRCUIT.
2. CHECK RF CABLE CONNECTIONS TO RF DECK.
1 INSPECT THE RF DECK FOR BAD CONNECTIONS OR OTHER DAMAGE.
2 CHECK ANTENNA SWITCHING NETWORK RECEIVER LEG INSERTION LOSS. REFER TO ANTENNA NETWORK SERVICING SECTION.
PERFORM COMPLETE RECEIVER ALIGNMENT. REFER TO ADJUSTMENTS SECTION OF MANUAL FOR PROCEDURE.
PERFORM RECEIVER STAGE GAIN TESTS. REFER TO TEXT FOR PROCEDURE.

EEPS—17624—O

UIT

OM

Receiver RF & IF
Troubleshooting Chart
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signal generator output level until the test set meter reads 0.2 volts AC (20 dB down from 2 volts AC). Move the portable test set MULT switch to the 0.2 V AC position if necessary.

NOTE

The output frequency of some signal generators will be "pulled" when the output level is near maximum. It may be necessary to reset the generator frequency to zero meter 4 as the output level is reduced.

Step 11. Note the signal generator output level. If the receiver rf and i-f board is functioning properly, this level should be 0.5 uV or less for a receiver without an rf preamplifier, or 0.25 uV or less for a receiver with an rf preamplifier.

1.2.2.2 Using Built-In Station Metering

NOTE

This section substitutes a separate AC voltmeter for the portable test set meter 11 position.

Step 1. The receiver rf and i-f board must be installed in a complete receiver for testing. Make sure the rf and i-f circuit board mounting screws are all secure and that all connections to the board are properly made.

Step 2. Be sure the receiver shield is in place.

Step 3. Apply ac input power to the station.

Step 4. Unsquelch the receiver by turning the SQUELCH control fully counterclockwise. "Private-Line" stations must also be PL disabled.

Step 5. Set the range switch on an ac voltmeter to the 2 V AC position and connect the voltmeter across the speaker terminals of the built-in station meter kit. Adjust the station VOLUME control for 2 volts as indicated on the voltmeter.

NOTE

The built-in station metering kit incorporates a DC voltmeter, not an AC voltmeter.

Step 6. Connect an rf signal generator to the receiver input connector.

Step 7. Set the signal generator controls as follows:

-- Set up the signal generator to produce a CW or unmodulated signal.

-- Set the generator output level to maximum.

-- Set the signal generator output frequency to the selected channel receive frequency. To set the signal generator on frequency without a frequency counter, adjust the generator frequency control until meter position 4 reads exactly zero.

Step 8. Slowly decrease the signal generator output level until the ac voltmeter reads 0.2 volts AC. Move the ac voltmeter switch to the 0.2 V AC position if necessary.

NOTE

The output frequency of some signal generators will be "pulled" when the output level is near maximum. It may be necessary to reset the generator frequency to zero meter 4 as the output level is reduced.

Step 9. Note the signal generator output level. If the receiver rf and i-f board is functioning properly, this level should be 0.5 uV or less for a receiver without an rf preamplifier, or 0.25 uV or less for a receiver with an rf preamplifier.

1.3 TROUBLESHOOTING

1.3.1 Visual Inspection

1.3.1.1 The first step in the troubleshooting procedure should be a thorough visual inspection of the receiver and, in particular, the receiver rf and i-f board. Corrosion and burned or damaged components are usually easily seen and may be the cause or a symptom of the receiver malfunction. Loose circuit board mounting screws, or a loose or improperly installed receiver shield are other easily found problems that can cause a considerable degradation in receiver performance.

1.3.1.2 After the "obvious" problems have been corrected, repeat the receiver rf and i-f board performance tests. If the tests still produce unsatisfactory results, refer to the receiver rf and i-f troubleshooting chart. The troubleshooting chart provides a systematic procedure for isolation of the defective stage and component.

1.3.1.3 As much information as possible has been included on the troubleshooting

TROUBLESHOOTING PREREQUISITIES

1. THE RECEIVER RF & IF BOARD MUST BE INSTALLED IN A COMPLETE RECEIVER FOR TESTING. BE SURE ALL CIRCUIT BOARD MOUNTING SCREWS ARE SECURE, SHIELDS INSTALLED, AND THAT ALL CONNECTIONS TO THE BOARD ARE PROPERLY MADE.
2. TURN STATION ON.
3. USING A TEK–37 ADAPTER CABLE, CONNECT A MOTOROLA PORTABLE TEST SET OR METER PANEL TO THE RADIO AS FOLLOWS:
   - A. CONNECT THE ADAPTER CABLE 20–PIN CONNECTOR TO THE RECEPTACLE ON THE FRONT OF THE TEST SET OR METER PANEL.
   - B. CONNECT THE ADAPTER CABLE RED "CONTROL" PLUG TO THE RECEPTACLE J3 ON THE UNIFIED CHASSIS INTERCONNECT BOARD.
   - C. CONNECT THE WHITE "METERING" PLUG TO THE METERING RECEPTACLE ON THE RECEIVER RF AND IF BOARD.
4. SET PORTABLE TEST SET SWITCHES AS FOLLOWS:
   - A. FUNCTION SWITCH TO THE RCVR POSITION
   - B. METER REVERSING SWITCH TO OFF POSITION
   - C. ADAPTER CABLE SENS SWITCH TO THE 100 mV POSITION. IF THE ADAPTER CABLE HAS NO SENS SWITCH, THE UNIT OPERATES AT 100 mV ALL OF THE TIME.
   - D. ADAPTER CABLE REFERENCE SWITCH TO POSITION A OR B.
   - E. SELECTOR SWITCH AS REQUIRED BY THE TROUBLESHOOTING PROCEDURE.
5. ON "PRIVATE–LINE" RADIOS, DISABLE THE PL DECODER BY SETTING THE PL SWITCH ON THE STATION CONTROL MODULE TO THE DISABLE POSITION.
6. SET THE SQUELCH CONTROL FULLY COUNTERCLOCKWISE (UNSQUELCHED).
7. SET THE VOLUME CONTROL FOR A COMFORTABLE LISTENING LEVEL.

RECEIVER RF AND IF TROUBLESHOOTING CHART

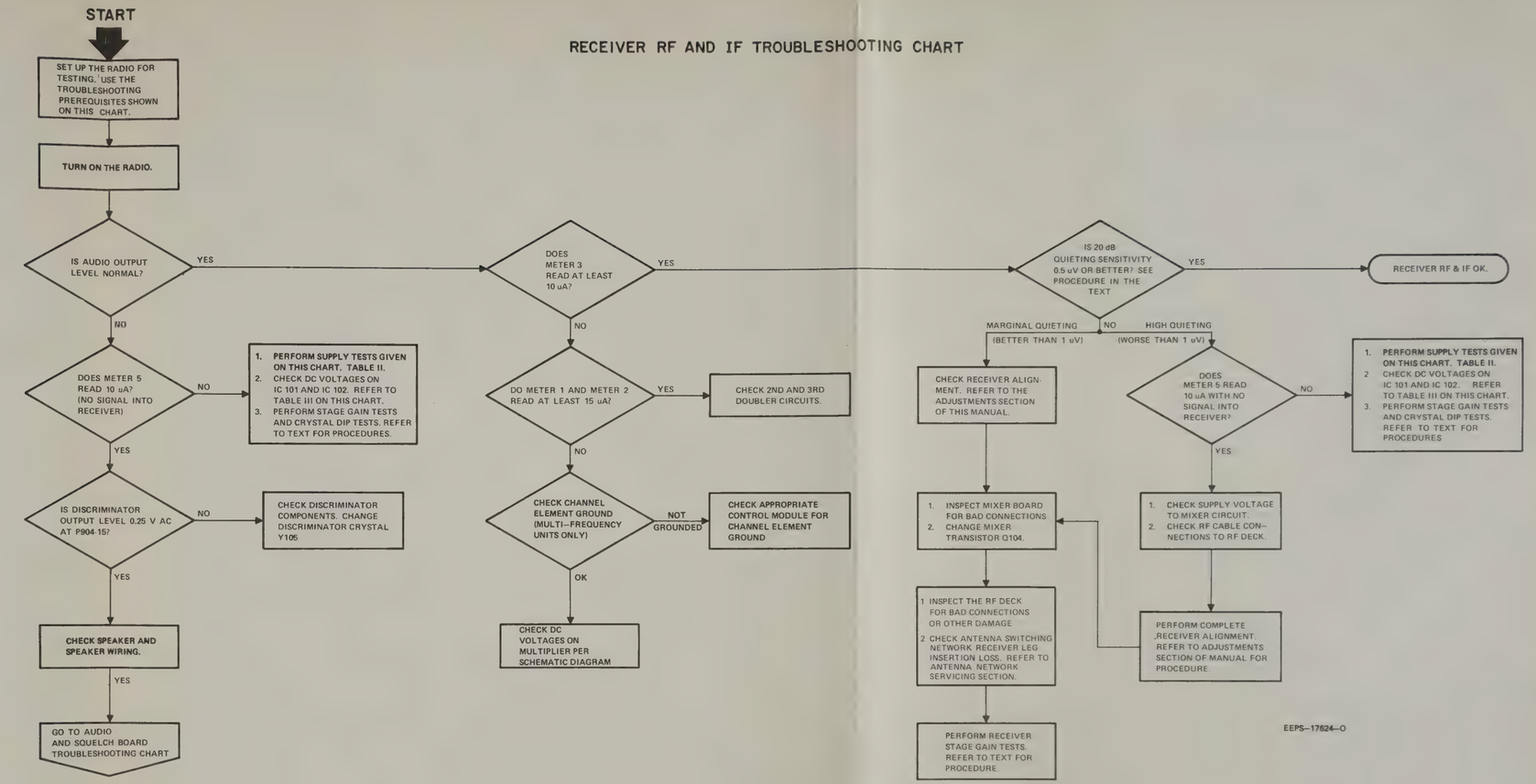
START
SET UP THE RADIO FOR TESTING. USE THE TROUBLESHOOTING PREREQUISITES SHOWN ON THIS CHART.
TURN ON THE RADIO.
IS AUDIO OUTPUT LEVEL NORMAL?
YES
NO
DOES METER 5 READ 10 uA? (NO SIGNAL INTO RECEIVER)
NO
1. PERFORM SUPPLY TESTS GIVEN ON THIS CHART. TABLE II.
2. CHECK DC VOLTAGES ON IC 101 AND IC 102. REFER TO TABLE III ON THIS CHART.
3. PERFORM STAGE GAIN TESTS AND CRYSTAL DIP TESTS. REFER TO TEXT FOR PROCEDURES.
YES
IS DISCRIMINATOR OUTPUT LEVEL 0.25 V AC AT P904-15?
NO
CHECK DISCRIMINATOR COMPONENTS. CHANGE DISCRIMINATOR CRYSTAL Y105
YES
CHECK SPEAKER AND SPEAKER WIRING.
YES
GO TO AUDIO AND SQUELCH BOARD TROUBLESHOOTING CHART
DOES METER 3 READ AT LEAST 10 uA?
YES
NO
DO METER 1 AND METER 2 READ AT LEAST 15 uA?
YES
CHECK 2ND AND 3RD DOUBLER CIRCUITS.
NO
CHECK CHANNEL ELEMENT GROUND (MULTI–FREQUENCY UNITS ONLY)
NOT GROUNDED
CHECK APPROPRIATE CONTROL MODULE FOR CHANNEL ELEMENT GROUND
OK
CHECK DC VOLTAGES ON MULTIPLIER PER SCHEMATIC DIAGRAM
IS 20 dB QUIETING SENSITIVITY 0.5 uV OR BETTER? SEE PROCEDURE IN THE TEXT
YES
RECEIVER RF & IF OK.
NO
MARGINAL QUIETING (BETTER THAN 1 uV)
HIGH QUIETING (WORSE THAN 1 uV)
CHECK RECEIVER ALIGNMENT. REFER TO THE ADJUSTMENTS SECTION OF THIS MANUAL.
1. INSPECT MIXER BOARD FOR BAD CONNECTIONS
2. CHANGE MIXER TRANSISTOR Q104.
1 INSPECT THE RF DECK FOR BAD CONNECTIONS OR OTHER DAMAGE
2 CHECK ANTENNA SWITCHING NETWORK RECEIVER LEG INSERTION LOSS. REFER TO ANTENNA NETWORK SERVICING SECTION.
PERFORM RECEIVER STAGE GAIN TESTS. REFER TO TEXT FOR PROCEDURE.
DOES METER 5 READ 10 uA WITH NO SIGNAL INTO RECEIVER?
NO
1. PERFORM SUPPLY TESTS GIVEN ON THIS CHART. TABLE II.
2 CHECK DC VOLTAGES ON IC 101 AND IC 102. REFER TO TABLE III ON THIS CHART.
3. PERFORM STAGE GAIN TESTS AND CRYSTAL DIP TESTS. REFER TO TEXT FOR PROCEDURES
YES
1. CHECK SUPPLY VOLTAGE TO MIXER CIRCUIT.
2. CHECK RF CABLE CONNECTIONS TO RF DECK.
PERFORM COMPLETE RECEIVER ALIGNMENT. REFER TO ADJUSTMENTS SECTION OF MANUAL FOR PROCEDURE.

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TABLE I
MINIMUM RECEIVER RF & IF METER READINGS TABLE
(NO INPUT SIGNAL APPLIED)

SELECTOR SWITCH POSITION	READING (MICRO-AMPS)	CIRCUIT METERED
1	15	CHANNEL ELEMENT OUTPUT
2	15	FIRST DOUBLER OUTPUT
3	15	SECOND DOUBLER OUTPUT
4	0±2	DISCRIMINATOR OUTPUT
5	10	SECOND I–F AMPLIFIER AND LIMITER

TABLE II
RECEIVER RF & IF DC INPUT VOLTAGES

TEST POINT	DESCRIPTION
P904-9	B+ CONTINUOUS (+13.8 V DC WITH REFERENCE TO CHASSIS)
P904-11	9.6 V DC CONTINUOUS (WITH REFERENCE TO CHASSIS) (±0.5 V)
P904-8	9.6 V DC CONTINUOUS (WITH REFERENCE TO CHASSIS) (±0.5 V)

TABLE III
NOMINAL RECEIVER INTEGRATED CIRCUIT DC VOLTAGES
(ALL READINGS ARE IN VOLTS DC, MEASURED WITH RESPECT TO CHASSIS)

PIN NO.	IC101 VOLTAGE	IC102 VOLTAGE
1	GND	2.8
2	GND	GND
3	2.8	2.8
4	6.6	6.6
5	9.3	9.3
6	7.2	7.2
7	6.4	6.4
8	2.8	2.8
9	2.8	2.8
10	GND	GND

NOTE: ALL VOLTAGES MAY VARY ±10% FROM NOMINAL READINGS SHOWN.

Receiver RF & IF
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chart. However, you will have to refer occasionally to the receiver rf and i-f schematic diagram and circuit board detail. Detailed procedures regarding alignment, integrated circuits, and AFC troubleshooting, receiver gain measurements, and crystal dip tests follow in the text of this section of the manual.

1.3.2 Alignment as a Troubleshooting Technique

Low test set readings, improper discriminator output, and otherwise abnormal performance are very often corrected by realignment. Therefore, alignment should be one of the first troubleshooting steps performed for these symptoms.

1.3.3 Troubleshooting Integrated Circuits

1.3.3.1 Integrated circuits (ICs) are very reliable components and should not be replaced unless it is definitely indicated that the IC is the defective component. Before replacing an IC, make sure that the external components in the circuit are normal.

1.3.3.2 The ICs on the receiver rf and i-f board may be checked by dc voltage measurements. Proper voltages are shown in the following table.

NOMINAL RECEIVER INTEGRATED CIRCUIT DC VOLTAGES

(All readings are in volts dc, measured with respect to chassis)

PIN NO.	IC101 VOLTAGE	IC102 VOLTAGE
1	GND	2.8
2	GND	GND
3	2.8	2.8
4	6.6	6.6
5	9.3	9.3
6	7.2	7.2
7	6.4	6.4
8	2.8	2.8
9	2.8	2.8
10	GND	GND

NOTE: All voltages may vary ±10% from nominal readings shown.

1.3.4 Troubleshooting the AFC

To check AFC operation, perform the following test:

Step 1. Connect the Motorola test set (or use built-in metering if so equipped) to monitor discriminator output (meter position 4).

Step 2. Connect an rf signal generator to the receiver input connector. Set up the generator to provide about 100 uV of unmodulated signal at the selected receive channel frequency.

Step 3. Insert a screwdriver or other shorting device through the AFC OFF hole in the receiver shield, shorting the plating beneath the hole to the receiver shield, and adjust the input signal frequency for a discriminator meter indication of approximately 6 uA off zero center scale.

Step 4. Remove the short. The test set meter indication should return to within 3 uA of zero center scale. If it does not, the AFC is malfunctioning.

Step 5. If the AFC is malfunctioning, either components on the receiver rf and i-f board or AFC circuitry in the channel element may be defective.

-- The board may be checked by tracing the AFC error voltage from the discriminator output to the channel element. Performing step 3 and removing the short should produce an error voltage of approximately 0.6 V dc (+ or - with respect to chassis, depending upon direction of the zero center offset) when measured with a voltmeter which has a minimum of 11 megohms input impedance. Check for this error voltage at P904-15, P904-14, P904-7 and at the AFC OFF plating near the channel element.

-- The AFC channel element may be checked by substituting a known good channel element.

1.3.5 Receiver Gain Measurements

A defective crystal in the i-f selectivity portion of the receiver can be located by measuring receiver gain voltages and performing crystal dip tests.

NOTE

Before making any receiver gain measurements, make sure the case of every filter crystal has a good conductive path to ground. An ohmmeter test should indicate less than 1 ohm between the crystal case and the receiver circuit board ground plating. A bad ground connection may cause errors in gain measurements.

Step 1. Proper receiver alignment is essential to this procedure. Complete receiver rf and i-f alignment is given in the Receiver Alignment section of this instruction manual. Leave alignment test equipment connected to perform this check.

Step 2. Refer to the following table of receiver gain measurements, the receiver rf and i-f schematic diagram, and the receiver rf and i-f circuit board detail.

NOTE

Receiver rf input voltages given in the table are those at the receiver input connector. If a pad or other attenuator is connected between the signal generator and the receiver rf input, the signal generator output control must be set to compensate for the loss in the pad.

EXAMPLES:

6 dB loss means V out of the pad = 1/2 V into the pad.

20 dB loss means V out of the pad = 1/10 V into the pad.

RECEIVER GAIN MEASUREMENTS

TEST POINT (See rf & i-f circuit board detail)	RECEIVER INPUT VOLTAGE (preset)	TEST POINT VOLTAGE ±6 dB	REMARKS
A	16 mV	100 mV	
B	8 mV	50 mV	
C	10 mV	50 mV	
D	15 mV	50 mV	
E	12 mV	50 mV	
F	15 mV	50 mV	
G	10 mV	600 mV	IC101 saturated output
H	6 uV	100 mV	
I	9 uV	100 mV	
J	12 uV	100 mV	
K	11 uV	100 mV	
L	20 uV	100 mV	
M	1 uV	750 mV	IC102 saturated output

Step 3. Set the signal generator output frequency to the receiver channel frequency ("0" reading on meter 4). Adjust the signal generator output to provide the required receiver input voltage for a particular test point as listed in the table. Then, using an rf voltmeter, measure the rf signal voltage between the test point and a nearby chassis ground point. At every test point the measured voltage should be within ±6 dB of the value given in the table.

Step 4. A high or low test point voltage measurement may indicate that the crystal at or ahead of the test point is defective. However, it may also indicate that an associated circuit component is defective. The extremely high-Q crystals used in "Micor"® "Compa-Station"® and Upright radios are very sensitive to associated circuit components. For example, if L125 is defective, it might appear that Y102 is bad. To isolate the defective component, perform the crystal dip tests described in the following procedure.

1.3.6 Crystal Dip Test

1.3.6.1 A defective crystal in the i-f selectivity portion of the receiver can be located by measuring receiver gain voltages and performing crystal dip tests.

1.3.6.2 The monolithic crystals used in "Micor" receivers are made up of two separate resonators on a single quartz blank. Each crystal has a pair of characteristic operating frequencies. One way to find the characteristic frequencies of each crystal is to short the crystal output to chassis ground, then monitor the crystal input voltage with an rf voltmeter while varying the signal generator frequency across the bandpass of the receiver. Low voltage points will occur at each of the crystal characteristic frequencies.

1.3.6.3 Figures 1 and 2 are plots of typical rf voltmeter readings obtained while testing good crystals. Note that the horizontal scales are calibrated in frequency, with f_o the channel frequency of the receiver. The vertical scales represent relative rf voltmeter readings. The bottom line is zero and the top line is maximum. Notice that each plot has a sharp minimum point above f_o and another below f_o. The table of crystal dip frequencies at the end of this section lists the frequencies at which these dip points should appear. If the measured dips fall outside the tolerances listed in the table, the crystal may be defective.

Step 1. Leave the test equipment set up as was done for the receiver gain measurements.

Step 2. If the receiver uses AFC, disable the AFC by connecting a jumper between test point "N" (see Receiver RF & IF Circuit Board Detail diagram) and chassis ground.

Step 3. Set the signal generator to f_o, the receiver channel frequency ("0" on meter 4). Adjust the generator output control for at least 50 mV at the receiver input connector.

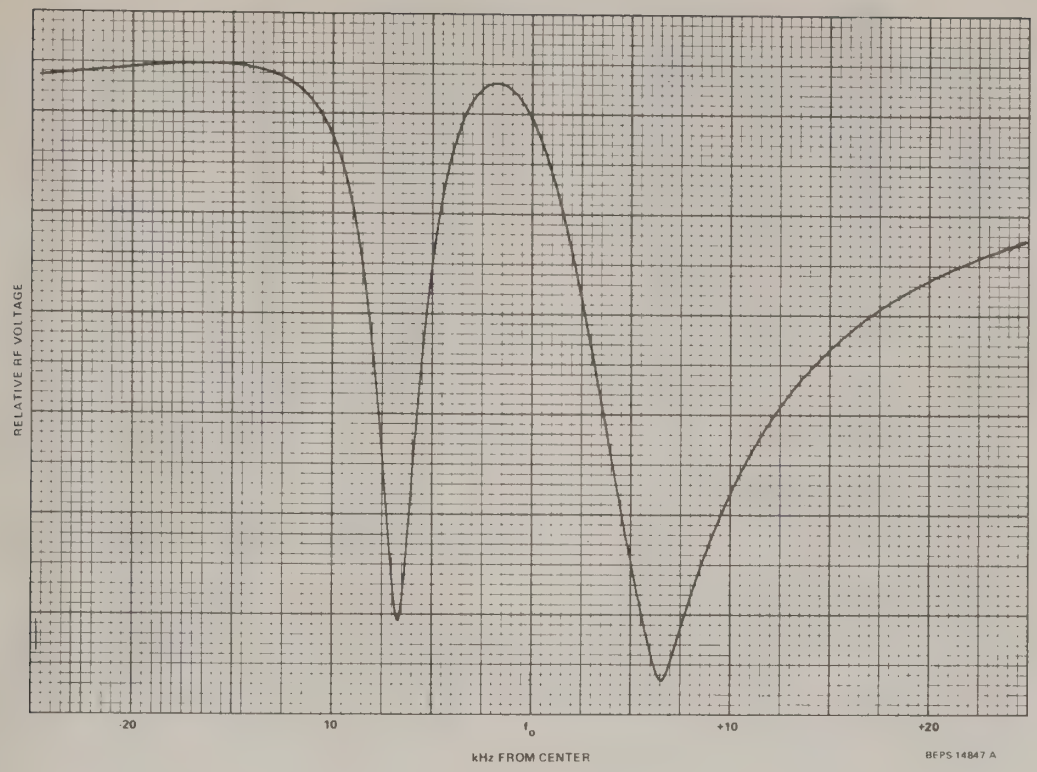


Figure 1.
Typical Plot of a Known Good Crystal in Position Y101 or Y103

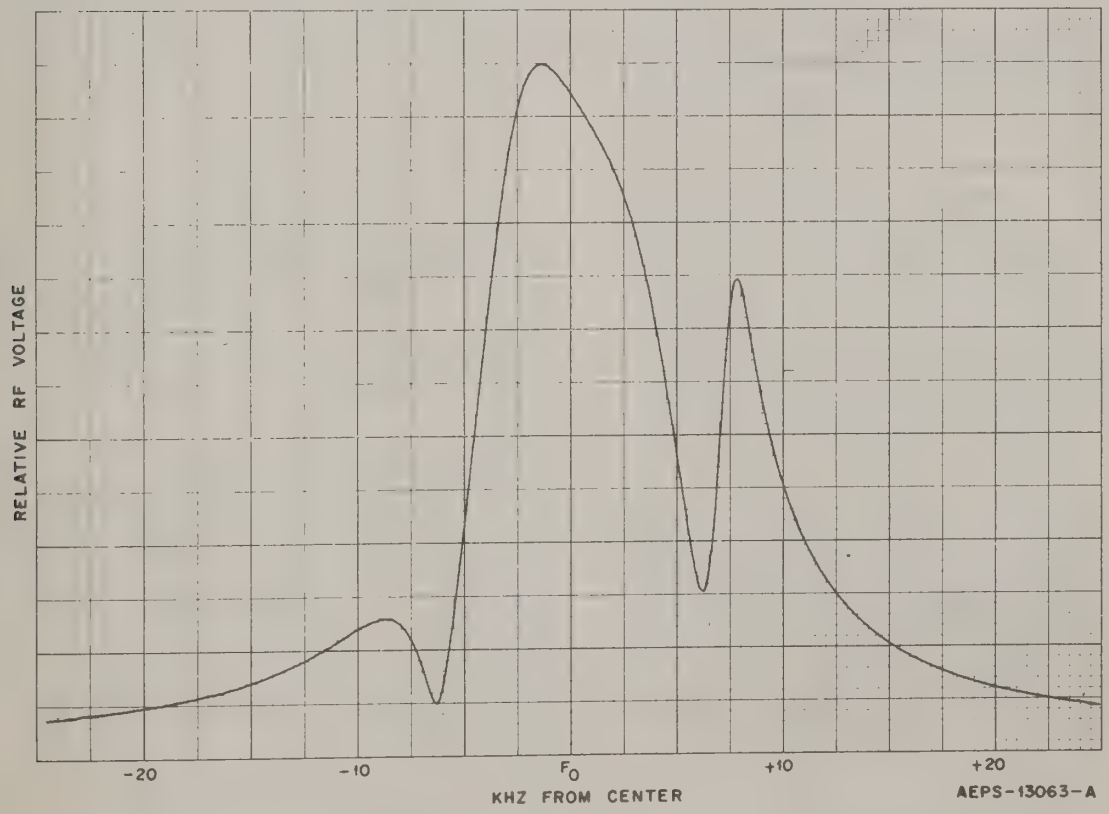


Figure 2.
Typical Dip Plot of a Known Good Crystal in Position Y102 or Y104

CRYSTAL DIP FREQUENCIES

CRYSTAL	TEST POINT GROUNDED	TEST POINT MONITORED	+ FREQUENCY DIP (kHz) ±2.5 kHz	- FREQUENCY DIP (kHz) ±2.5 kHz
Y101	C	B	6.0	7.0
Y102	E	D	6.5	6.5
Y103	I	H	6.0	7.0
Y104	K	J	6.5	6.5

Step 4. Refer to the crystal dip frequency table. To test a particular crystal, find it in the table, ground the indicated test point, and connect an rf voltmeter between the monitored test point and a nearby chassis ground point.

Step 5. Starting at f_o, slowly increase the signal generator frequency while watching for a dip in the rf voltmeter reading. This dip should be sharp, so increase the signal generator frequency very slowly and watch the rf voltmeter closely. When the dip is cound, write down the frequency counter reading.

Step 6. Return the signal generator to f_o. Then watch the rf voltmeter while slowly decreasing the signal generator frequency. When the dip is found, write down the frequency counter reading.

Step 7. Compare your test results with the frequencies and tolerances listed in the table for the crystal you have tested. If the measured dips fall outside the tolerances listed in the table, the crystal may be defective. Continue with this procedure to isolate the bad component.

Step 8. FOR TEST PURPOSES ONLY, exchange the suspected crystal with another from the receiver. Be sure you note the polarity of the crystal when you make the change. Repeat the receiver gain measurement and crystal dip test on the suspected crystal in the new location. If the suspected crystal tests bad again, consider it defective and replace it. If the crystal tests good, look for defective associated components at the original crystal location.

Step 9. When the tests are completed, be sure all jumpers connected during the test are removed and that any moved crystals are returned to their original locations. Refer to the parts list and circuit board detail for correct part location. Note crystal polarity when replacing crystals.

1.3.7 Field Conversion to Shifted IF

A standard 11.7 MHz i-f receiver can easily be converted to operate at the shifted i-f of 11.8 MHz. Replace crystal filters Y101 through Y105 with the 11.8 MHz parts; refer to the parts list for the TLE8610A Shifted IF Crystal Kit for the part numbers. Finally, replace the channel element, using the 11.8 MHz i-f formula for calculating the crystal frequency.

2. AUDIO AND SQUELCH BOARD

NOTE

The audio and squelch board must be installed in a radio set for testing to provide the necessary power and ground connections.

2.1 PERFORMANCE TESTS

The performance tests may be used for troubleshooting to isolate the point of abnormal operation. They may also be used after repair to assure that the board is operating properly before it is returned to service.

2.1.1 Audio Amplification

The audio section of the audio and squelch board combined with the separate audio power amplifier transistors will provide at least 10 watts audio output at less than 5 per cent distortion from a 3.0 kHz deviated, 1 kHz modulated on-frequency signal applied to the receiver input receptacle.

Step 1. Replace the speaker with an 8-ohm, 15 watt non-inductive resistor.

Step 2. Set the SQUELCH control fully counterclockwise (unsquelched). "Private-Line" stations must also be PL disabled by placing the PL monitor switch (STATION CONTROL MODULE) in the DISABLE position.

Step 3. Connect an rf signal generator to the receiver input receptacle and adjust it to the receiver frequency.

Step 4. Adjust the signal generator for 1000 microvolt output, modulated with 1000 Hz tone at ±5.0 kHz deviation.

Step 5. Connect an AC voltmeter to pin J903-7 at the receiver interconnect board.

Step 6. Adjust the line level control R203 for 150 mV ac rms.

Step 7. Reduce the deviation to ±3.0 kHz.

Step 8. Connect an AC voltmeter across the 8-ohm resistor.

Step 9. Adjust the VOLUME control until 9.0 volts ac rms is read on the ac voltmeter (this represents 10 watts).

Step 10. Measure distortion at 10 watts audio power output. It should be less than 5 per cent.

2.1.2 Squelch Control

2.1.2.1 Specifications

Spec 1. The squelch section of the receiver audio and squelch board shall enable the audio section when an rf signal level greater than 6 dB noise quieting (one-half the discriminator output level with no signal input) is applied to the receiver with the SQUELCH control set at threshold. When the signal is removed from the station, the audio channel shall become disabled after approximately 150 milliseconds. When an input signal greater than that required for approximately 20 dB noise quieting is removed from the station, the audio channel shall become disabled immediately.

Spec 2. When the SQUELCH control is turned fully clockwise (tight squelch) an input signal that produces about 20 dB noise quieting shall be required to enable the audio channel.

Spec 3. The squelch section shall inhibit audio output when no input signal is received.

Spec 4. In "Private-Line" coded squelch stations, the squelch section of the receiver's audio and squelch board shall perform as described in the preceding specification 1 while the radio set is PL disabled.

Spec 5. In PL operation, the squelch section shall inhibit audio output when the proper PL code is not received, regardless of the input signal strength.

2.1.2.2 Procedure

2.1.2.2.1 Carrier Squelch Stations

Step 1. Turn the station on and adjust the SQUELCH control clockwise from the full counter-clockwise position until the receiver just quiets (threshold squelch).

Step 2. Measure the resistance of IC202-6 and -7 with reference to ground. Both pins should be less than 1000 ohms.

NOTE

Erroneous readings will be obtained in resistance measurements if the voltage between the ohmmeter probes exceeds approximately 5.0 volts dc.

Step 3. Connect a signal generator to the receiver input receptacle and adjust it to the receiver frequency. Modulate the generator output with a 1000 Hz tone at ±3.0 kHz deviation.

Step 4. Increase the signal generator output slowly until the receiver just unsquelches. Remove the modulation from the signal generator. Unsquelching should occur at a generator output that produces 6 dB noise quieting, or less.

Step 5. Measure the resistances of IC202-6 and -7 with reference to ground. Pin 6 should be greater than 100k ohms and pin 7 should be greater than 45k ohms.

Step 6. Increase the signal generator output until approximately 12 dB noise quieting is obtained. Remove the rf signal from the station input either by turning off the signal generator or by using a relay in series with the signal generator output. A long "squelch tail" should occur. If a calibrated, triggered sweep oscilloscope is available for measurement, the duration of the "squelch tail" should be approximately 150 milliseconds as measured at the speaker.

Step 7. Increase the signal generator output to produce 30 dB noise quieting. Turn off the rf signal and note the "squelch tail" duration. It should be no more than a "click". The duration should be less than 10 milliseconds.

Step 8. Turn the SQUELCH control fully clockwise (tight squelch).

Step 9. Adjust the signal generator output level until the receiver just unsquelches. Unsquelching should occur at a generator output that produces approximately 20 dB noise quieting.

2.1.2.2.2 "Private-Line" Tone-Coded Stations

Step 1. Disable the PL circuitry by placing the PL monitor switch in the DISABLE position.

Step 2. Perform previously described carrier squelch station procedure.

Step 3. Return the station to PL operation. On stations using "AND" squelch operation, also turn the SQUELCH control fully counterclockwise during this test.

Step 4. Vary generator output between minimum output and 1000 microvolt output while checking the resistances of IC202-6 and -7 with reference to ground. Both resistances should remain at less than 1000 ohms.

Step 5. Modulate the on-frequency generator output with a PL tone for ±0.5 to ±1 kHz deviation and 1000 Hz tone for ±3.0 kHz overall deviation.

Step 6. Increase the signal generator output slowly until the receiver just unsquelches. Unsquelching should occur at a generator output that produces 6 dB quieting, or less.

2.2 TROUBLESHOOTING

2.2.1 Check Input Voltages

A malfunction in the audio and squelch operation may be due to the loss of dc input voltages which can be caused by this board or another section of the station. Since there are only two input voltages applied to this board, it is advantageous to verify their presence before beginning extensive troubleshooting.

P903-4	+9.6 V dc in respect to chassis
P903-16	Audio A+ (approximately +13.6 V dc in respect to A-)

In a negative ground system, audio A- is at chassis potential. In a positive ground system, audio A+ is at chassis potential.

2.2.2 Isolating Defective Components

2.2.2.1 If tests indicate abnormal performance, a logical troubleshooting procedure should be followed to isolate the defective component efficiently. Results of performance tests usually localize the malfunction to one or two stages. The accompanying troubleshooting chart summarizes these results in a logical sequence. A few waveforms, voltage and resistance checks in the suspected circuit should readily isolate the defective component when compared with those on the schematic diagram.

2.2.3 Troubleshooting Integrated Circuits

Integrated circuits (ICs) are very reliable components and should not be replaced until all checks have proven definitely that the IC is the defective component. Make sure that the external components in the circuit are normal. The ICs on the audio and squelch board may be checked by dc voltage measurements although signal tracing with an oscilloscope is preferred.

2.2.4 Stage Gain Measurements

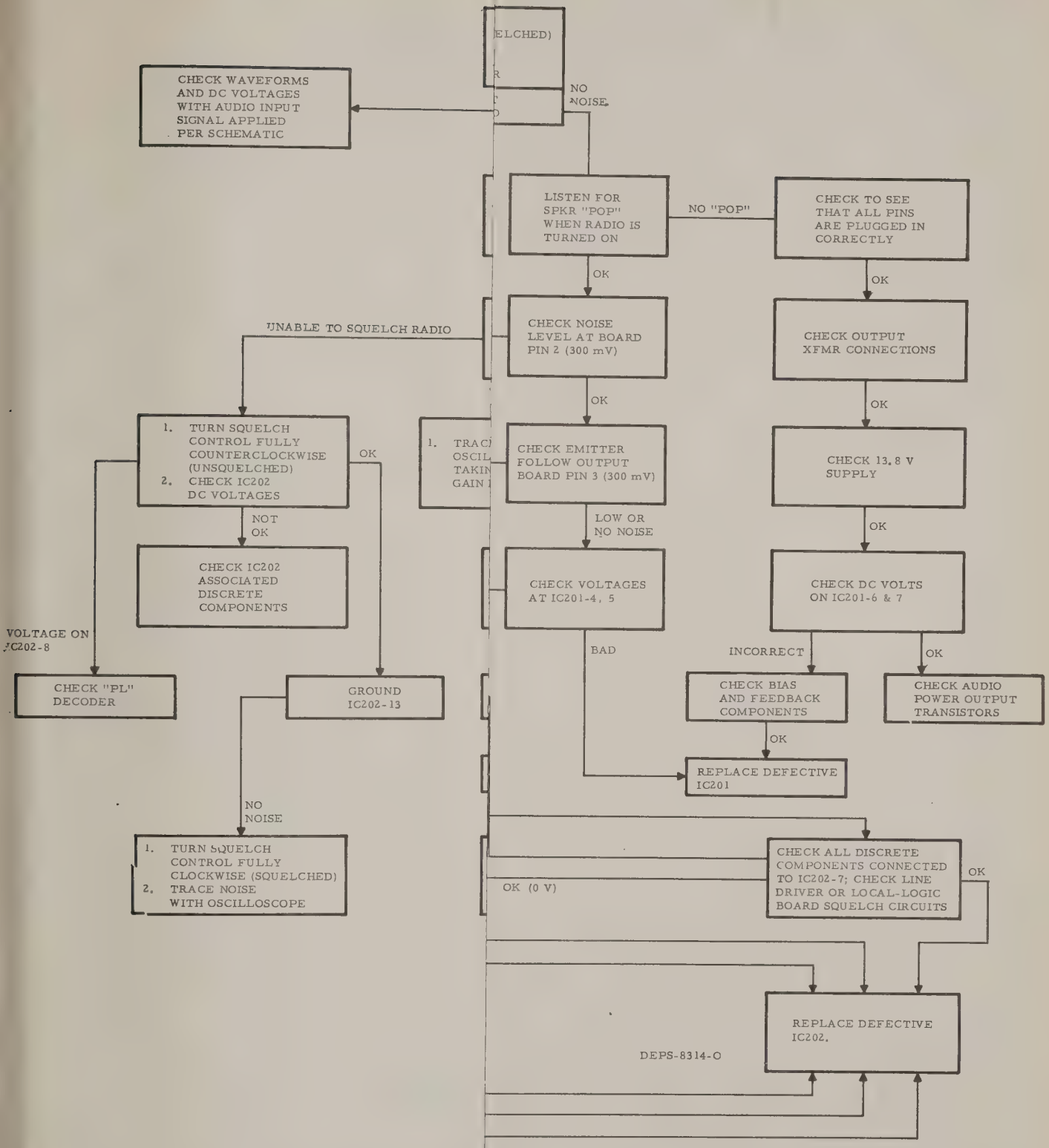
2.2.4.1 Squelch Circuitry

2.2.4.1.1 This troubleshooting procedure may be used to isolate a squelch malfunction occuring before the detector to a specific stage. The test is performed by injecting an ac signal at the input to the squelch circuitry and noting results obtained with an ac voltmeter. Most accurate results are obtained by taking dB gain and loss measurements between points as illustrated in Figure 3. Individual point voltage checks may also be used to quickly verify proper squelch input circuitry operation but this is not an adequate test to prove the circuitry is defective (refer to the following table and Figure 3). Tolerance addition may cause increasing variation from the typical readings in the table as readings are taken further from the injected signal point.

2.2.4.1.2 The following procedure may be used for loss and gain or signal level measurements while injecting a 3 kHz or 30 kHz signal. In "Private-Line" tone-coded squelch stations, PL operation will not affect this test.

Step 1. Turn the VOLUME control fully counterclockwise (off), or to a comfortable listening level, if desired.

Step 2. Turn the SQUELCH control fully clockwise (squelched) and turn the station on.



Receiver Audio and Squelch
Troubleshooting Chart
Motorola No. DEPS-8314-O
3/20/75-UP

Step 9. Adjust the signal generator output level until the receiver just unsquelches. Unsquelching should occur at a generator output that produces approximately 20 dB noise quieting.

2.1.2.2.2 "Private-Line" Tone-Coded Stations

Step 1. Disable the PL circuitry by placing the PL monitor switch in the DISABLE position.

Step 2. Perform previously described carrier squelch station procedure.

Step 3. Return the station to PL operation. On stations using "AND" squelch operation, also turn the SQUELCH control fully counterclockwise during this test.

Step 4. Vary generator output between minimum output and 1000 microvolt output while checking the resistances of IC202-6 and -7 with reference to ground. Both resistances should remain at less than 1000 ohms.

Step 5. Modulate the on-frequency generator output with a PL tone for ±0.5 to ±1 kHz deviation and 1000 Hz tone for ±3.0 kHz overall deviation.

Step 6. Increase the signal generator output slowly until the receiver just unsquelches. Unsquelching should occur at a generator output that produces 6 dB quieting, or less.

2.2 TROUBLESHOOTING

2.2.1 Check Input Voltages

A malfunction in the audio and squelch operation may be due to the loss of dc input voltages which can be caused by this board or another section of the station. Since there are only two input voltages applied to this board, it is advantageous to verify their presence before beginning extensive troubleshooting.

P903-4	+9.6 V dc in respect to chassis
P903-16	Audio A+ (approximately +13.6 V dc in respect to A-)

In a negative ground system, audio A- is at chassis potential. In a positive ground system, audio A+ is at chassis potential.

2.2.2 Isolating Defective Components

2.2.2.1 If tests indicate abnormal performance, a logical troubleshooting procedure should be followed to isolate the defective component efficiently. Results of performance tests usually localize the malfunction to one or two stages. The accompanying troubleshooting chart summarizes these results in a logical sequence. A few waveforms, voltage and resistance checks in the suspected circuit should readily isolate the defective component when compared with those on the schematic diagram.

2.2.3 Troubleshooting Integrated Circuits

Integrated circuits (ICs) are very reliable components and should not be replaced until all checks have proven definitely that the IC is the defective component. Make sure that the external components in the circuit are normal. The ICs on the audio and squelch board may be checked by dc voltage measurements although signal tracing with an oscilloscope is preferred.

2.2.4 Stage Gain Measurements

2.2.4.1 Squelch Circuitry

2.2.4.1.1 This troubleshooting procedure may be used to isolate a squelch malfunction occuring before the detector to a specific stage. The test is performed by injecting an ac signal at the input to the squelch circuitry and noting results obtained with an ac voltmeter. Most accurate results are obtained by taking dB gain and loss measurements between points as illustrated in Figure 3. Individual point voltage checks may also be used to quickly verify proper squelch input circuitry operation but this is not an adequate test to prove the circuitry is defective (refer to the following table and Figure 3). Tolerance addition may cause increasing variation from the typical readings in the table as readings are taken further from the injected signal point.

2.2.4.1.2 The following procedure may be used for loss and gain or signal level measurements while injecting a 3 kHz or 30 kHz signal. In "Private-Line" tone-coded squelch stations, PL operation will not affect this test.

Step 1. Turn the VOLUME control fully counterclockwise (off), or to a comfortable listening level, if desired.

Step 2. Turn the SQUELCH control fully clockwise (squelched) and turn the station on.

START

1. TURN RADIO ON
2. TURN SQUELCH CONTROL COUNTERCLOCKWISE (UNSQUELCHED)
3. ON "PL" STATION, "PL" DISABLE
4. TURN VOLUME CONTROL FULLY CLOCKWISE (ON)
5. ON LOCAL STATIONS, OPEN SHUNT-SWITCH CONNECTOR

AUDIO INPUT SIGNAL APPLIED

AUDIO OUTPUT WEAK AND/OR DISTORTED.

CHECK WAVEFORMS AND DC VOLTAGES WITH AUDIO INPUT SIGNAL APPLIED PER SCHEMATIC

EXCEPT FOR IC202-6 AND -7, RESISTANCE READINGS ARE TAKEN WITH RADIO SET POWER OFF

NOISE

ADJUST SQUELCH CONTROL FOR THRESHOLD SQUELCH (NOISE JUST CUTS OFF)

INSUFFICIENT NOISE ATTENUATION

NO NOISE CONDITION

UNABLE TO SQUELCH RADIO

CHECK THRESHOLD SQUELCH SENSITIVITY

LOW

OK

1. TURN SQUELCH CONTROL FULLY COUNTERCLOCKWISE (UNSQUELCHED)
2. CHECK IC202 DC VOLTAGES

OK

NOT OK

CHECK IC202 ASSOCIATED DISCRETE COMPONENTS

VOLTAGE ON IC202-8

CHECK "PL" DECODER

GROUND IC202-13

NO NOISE

1. TURN SQUELCH CONTROL FULLY CLOCKWISE (SQUELCHED)
2. TRACE NOISE WITH OSCILLOSCOPE

1. TRACE NOISE WITH OSCILLOSCOPE TAKING STAGE GAIN MEASUREMENTS

1. TURN SQUELCH CONTROL FULLY CLOCKWISE (SQUELCHED)
2. CHECK TIGHT SQUELCH SENSITIVITY

LOW

CHECK IC202 DC VOLTAGES

OK

TAKE STAGE GAIN MEASUREMENTS

OK

CHECK IC202 ASSOCIATED DISCRETE COMPONENTS

CHECK DISCRETE COMPONENTS ASSOCIATED WITH IC202-1, -2, -3, -4, AND -15.

OK

CHECK DC VOLTAGES ON IC202-1, -2, -3 AND -15.

OK

1. BYPASS IC202-4 TO GROUND WITH A .1 uF CAP. CHECK VOLTAGE AT IC202-13

OK

1. LEAVE IC202-4 SHORTED TO GROUND
2. CHECK IC202-6 & -7 RESISTANCES

LOW

1. SHORT IC202-4 TO GROUND
2. CHECK VOLTAGE AT IC202-13

OK

STILL LOW

LOW

P13 LOW

CHECK VOLTS AT IC202-13 & -14

PIN 14 LOW, PIN 13 OK

CHECK FOR SHORT OR HI-LEAKAGE PATH AT IC202-14, INTERCONNECT BOARD, INTERCABLING, OR DEFECTIVE "PL" SWITCH

ALL OK

VOLTAGE ON 10

CHECK DC VOLTS AT IC202-10

BOTH OK

BAD

OK (0 V)

BOTH LOW (<1K)

ONE LOW & ONE HIGH

CHECK RESISTANCES FOR IC202-6 & -7 TO GROUND

LOW OR NO NOISE

CHECK RECEIVER AND INTERCONNECT BOARD, AND POWER SUPPLY 9.6 V

LOW OR NO NOISE

CHECK NOISE LEVEL AT BOARD PIN 2 (300 mV)

OK

CHECK PRE-AMP OUTPUT PIN 7 (150 mV)

OK

CHECK EMITTER FOLLOW OUTPUT BOARD PIN 3 (300 mV)

OK

CHECK "PL" DECODER

OK

CHECK JU201 IN "PL" RADIOS

OK

CHECK VOLTAGES AT IC201-4, 5

LOW OR NO NOISE

BAD

REPLACE DEFECTIVE IC201

NO "POP"

LISTEN FOR SPKR "POP" WHEN RADIO IS TURNED ON

OK

CHECK TO SEE THAT ALL PINS ARE PLUGGED IN CORRECTLY

OK

CHECK OUTPUT XFMR CONNECTIONS

OK

CHECK 13.8 V SUPPLY

OK

CHECK DC VOLTS ON IC201-6 & 7

INCORRECT

CHECK BIAS AND FEEDBACK COMPONENTS

OK

OK

CHECK AUDIO POWER OUTPUT TRANSISTORS

NO NOISE

CHECK ALL DISCRETE COMPONENTS CONNECTED TO IC202-7; CHECK LINE DRIVER OR LOCAL-LOGIC BOARD SQUELCH CIRCUITS

OK

REPLACE DEFECTIVE IC202.

DEPS-8314-O

Receiver Audio and Squelch
Troubleshooting Chart
Motorola No. DEPS-8314-O
3/20/75-UP

SQUELCH INTEGRATED CIRCUIT
AC MEASUREMENTS AND STAGE GAIN

Connect AC voltmeter to IC202-Pin	3 kHz Input Signal		30 kHz Input Signal	
	AC voltage (mV rms)	Gain or loss from previous reading	AC voltage (mV rms)	Gain or loss from previous reading
P903-9	10.0	----	10.0	----
15	3.5	9 dB loss	9.5	0.5 dB loss
1	40.0	21 dB gain	110.0	21 dB gain
2	7.0	15 dB loss	85.0	2 dB loss
3	80.0	21 dB gain	950.0	21 dB gain
4	24.0	10 dB loss	750.0	2 dB loss

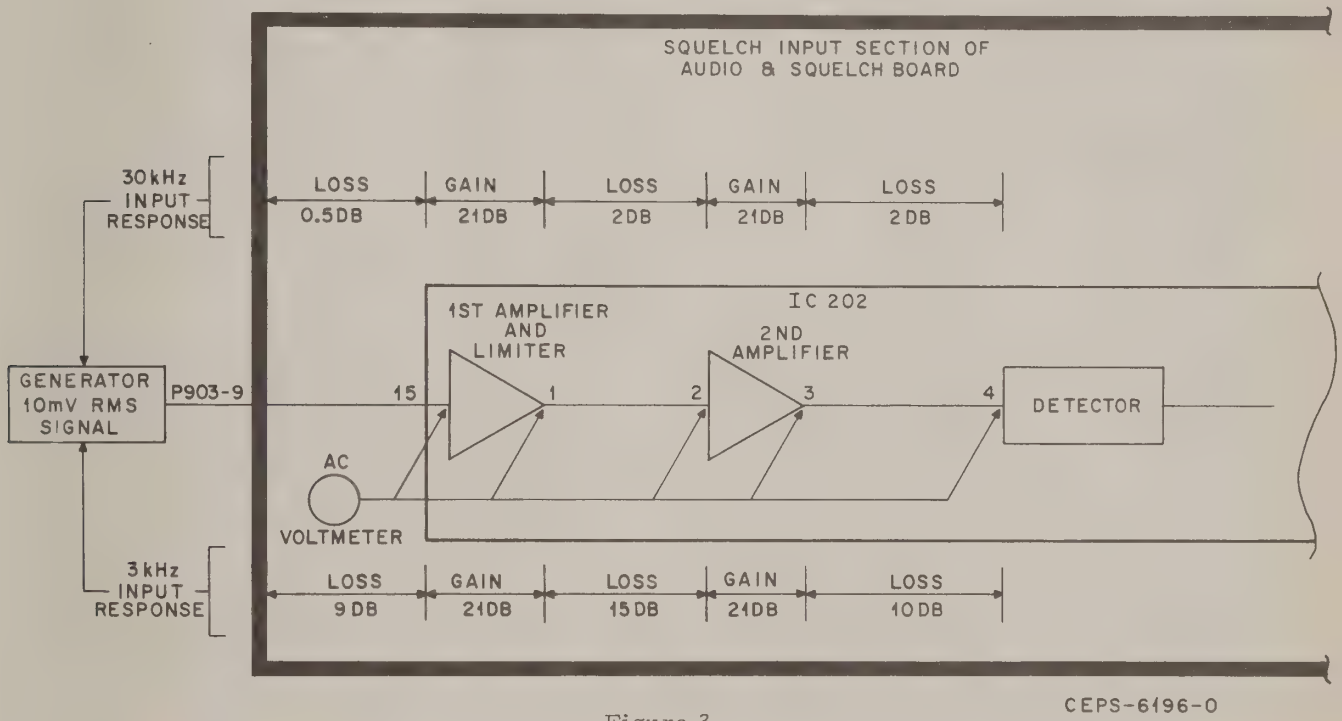


Figure 3.
Squelch Circuitry Stage Gain Measurements

Step 3. Inject a 1000 microvolt, on-channel signal at the receiver input receptacle. This "quiets" the discriminator output and prevents erroneous test readings.

Step 4. Inject a 3 kHz, 10 millivolt rms signal at the receiver audio & squelch board at P903-9.

Step 5. Take loss and gain measurements or signal level measurements as required.

Step 6. Repeat the preceding test using a 30 kHz signal in place of the 3 kHz signal in step 4.

2.2.4.2 Audio Circuitry

AC voltage measurements and waveforms are given where applicable on the schematic diagram. Refer to this diagram for pertinent information when taking audio stage gain measurements.

3. AUDIO POWER AMPLIFIER

3.1 PERFORMANCE CHECKS

Performance checks on this board consist of taking resistance measurements between the transistor elements. It should be noted, however, that some multimeters have insufficient voltage at the ohmmeter test probes to forward bias a transistor junction and cannot be used. A volt-ohm meter with 1000 to 20,000 ohms-per-volt sensitivity is required for these checks. Compare the resistance readings with those in the transistor resistance measurement table.

TRANSISTOR RESISTANCE MEASUREMENT CHECK
(Board removed from radio - Transistors mounted on board)

Ohmmeter Connections		Proper Resistance	
Positive Lead Connected to	Negative Lead Connected to	PNP Transistor	NPN Transistor
Base	Emitter, then Collector	Infinite	5-30 Ohms, Both
Emitter, then Collector	Base	5-30 Ohms, Both Cases	Infinite
Collector	Emitter	Infinite	Infinite
Emitter	Collector	Infinite	Infinite

Failure to obtain these results indicates a defective transistor which must be replaced.

NOTE

Do not insert meter test probe tips into female connectors on the board. To do so could damage the connectors and result in poor electrical interconnection with the audio and squelch board.

3.2 TRANSISTOR REPLACEMENT

3.2.1 Care must be exercised to prevent damage (such as a scratch) to the mounting plate anodizing at the transistor-mounting plate interface. Should the anodizing in this area become scratched, original performance can only be restored by the use of a new anodized plate. The plate can not be "repaired" by the use of any type of insulating washer without a loss in thermal conduction capability.

3.2.2 Factory replacement transistors are supplied with pre-formed leads to properly fit onto the aluminum mounting plate and circuit board. A new compression washer is also included.

Step 1. Apply a thin, even coat of silicon grease to the metallic area of the transistor.

Step 2. Mount the transistor using the new compression washer. Do not solder leads at this time. Tighten the transistor mounting screw to 6 inch-pounds.

NOTE

Do not damage the transistor by over tightening the mounting screw. If no accurate method of measuring torque is available, tighten the mounting screw until it just "touches" the compression washer. Then turn the mounting screw 1/4 turn more.

Step 3. Solder transistor leads to printed circuit board.

RECEIVER INTERCONNECT BOARD

REFERENCE SYMBOL

PARTS LI

TLN5646A/T
Receiver Inte

C1 thru 4, 6 thru 9, 11, 12, 14, 31 thru 34, 36 thru 39, 41, 42, 44
C5, 10, 13, 15 thru 30, 35, 40, 43, 45 thru 60
C951
C952, 953

CR951 thru 954, 957

L1 thru 4, 6 thru 9, 11, 12, 14
L5, 10, 13, 22, 23, 27 thru 30
L15 thru 21, 24, 25, 26

L901

P6

P6

R951

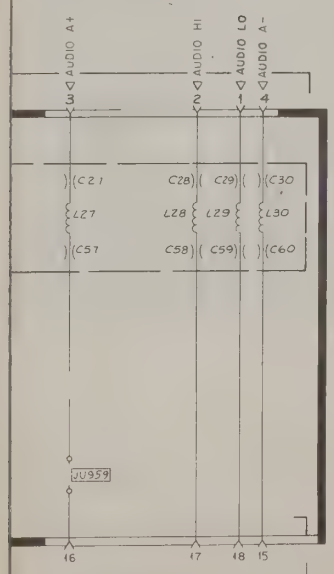
CHART

	FUNCTION
	E NOTE 953
	ECIAL APPLICATION
	SQ. ATTENUATE (REMOTE)
	SQ.
	ECIAL APPLICATION
	E NOTE 954
	E NOTE 954
	ECIAL APPLICATION
	DIO A+
	E NOTE 951

NOTE:
For optimum
ordered by M

ITH TLN1249A SQUELCH

S WITH TLN1249A SQUELCH



FUNCTION --

Interconnects various receiver circuit boards to the unified chassis interconnect board. Model differences are primarily rf filtering.

NOTES

951 JU960 IS CUT FOR DIGITAL "PL" REPEATER STATIONS AND FULL DUPLEX DIGITAL "PL" BASE STATIONS

952 FILTERING COMPONENTS ARE USED ONLY WITH THE TLN5646A, TLN5655A, TRN6196A AND TRN6308A MODELS. THE TRN6196A AND TRN6308A MODELS USE ALL FILTERING COMPONENTS (C1–C60 AND L1–L30). THE TLN5646A MODEL USES ALL FILTERING COMPONENTS EXCEPT AS FOLLOWS

CAPACITORS C1–C4, C6–C9, C11, C12, C14, C31–C34, C36 -C39, C41, C42, C44.
CHOKES L1–L4, L6–L9, L11, L12, L14.

THE TLN5655A MODEL USES ALL FILTERING COMPONENTS EXCEPT AS FOLLOWS

CAPACITORS C1–4, C6–9, C11, C12, C13–C22, C24, C26–C34, C36–C39, C41–C52, C54, C56–C60.
CHOKES L1–L4, L6–L9, L11–L22, L24, L26–L30

THE TLN5648A MODEL DOES NOT USE ANY OF THESE FILTERING COMPONENTS BUT INCORPORATES "THRU" PLATING INSTEAD. (PLATING EXIST SIMULTANEOUSLY.)

953 JU951 IS CONNECTED IN SINGLE–FREQUENCY RECEIVERS ONLY. RECEIVER CHANNEL ELEMENT IS ALWAYS ACTIVATED.

954 AN OPTIONAL MODE OF RECEIVER OPERATION KNOWN AS "AND SQUELCH" CAN BE ADDED WHEN DESIRABLE. THIS FEATURE PROVIDES "VARIABLE PL SENSITIVITY" (PL–CODED SQUELCH PLUS ADJUSTABLE NOISE–ACTIVATED (CARRIER) SQUELCH).
IN THIS MODE, THE RECEIVER AUDIO CHANNEL IS ACTIVATED WHEN A PL CODE IS RECEIVED AND THE CARRIER SQUELCH THRESHOLD LEVEL IS EXCEEDED. SINCE THE CARRIER (NOISE–ACTIVATED) SQUELCH CIRCUIT SENSITIVITY IS ADJUSTABLE, AND SINCE IT IS ONE OF THE CONTROLLING FACTORS IN THE SQUELCHING OF RECEIVER AUDIO, THE OPERATION CAN BE APTLY DESCRIBED AS "VARIABLE PL SENSITIVITY". THUS "AND SQUELCH" DENOTES BOTH PL–CODED SQUELCH AND CARRIER SQUELCH OPERATING SIMULTANEOUSLY. CR955, CR956, & R952 ARE USED AND JUMPERS JU956 AND JU957 ARE OMITTED FOR "AND" SQUELCH OPERATION (JU204 ON AUDIO & SQUELCH BOARD MUST ALSO BE CUT) AND ARE NOT PART OF THE RECEIVER INTERCONNECT BOARD.

955 TWO RCVR STATIONS USE THE TLN5655A VERSION BOARD TO INTERCONNECT THE 2ND RCVR TO THE UNIFIED CHASSIS INTERCONNECT BOARD. THIS VERSION BOARD DOES NOT PLUG DIRECTLY INTO THE UNIFIED CHASSIS BOARD BUT RATHER IS INTERCONNECTED VIA P6. P6 IS CONNECTED TO THE RCVR INTERCONNECT BOARD J AS DETAILED IN THE 2ND RCVR CONNECTION TABLE

956. CR957 REMOVED ON TLN6196A FOR REPEAT OR DUPLEX OPERATION.

TRANSISTOR RESISTANCE MEASUREMENT CHECK
(Board removed from radio - Transistors mounted on board)

Ohmmeter Connections		Proper Resistance	
Positive Lead Connected to	Negative Lead Connected to	PNP Transistor	NPN Transistor
Base	Emitter, then Collector	Infinite	5-30 Ohms, Both
Emitter, then Collector	Base	5-30 Ohms, Both Cases	Infinite
Collector	Emitter	Infinite	Infinite
Emitter	Collector	Infinite	Infinite

Failure to obtain these results indicates a defective transistor which must be replaced.

NOTE

Do not insert meter test probe tips into female connectors on the board. To do so could damage the connectors and result in poor electrical interconnection with the audio and squelch board.

3.2 TRANSISTOR REPLACEMENT

3.2.1 Care must be exercised to prevent damage (such as a scratch) to the mounting plate anodizing at the transistor-mounting plate interface. Should the anodizing in this area become scratched, original performance can only be restored by the use of a new anodized plate. The plate can not be "repaired" by the use of any type of insulating washer without a loss in thermal conduction capability.

3.2.2 Factory replacement transistors are supplied with pre-formed leads to properly fit onto the aluminum mounting plate and circuit board. A new compression washer is also included.

Step 1. Apply a thin, even coat of silicon grease to the metallic area of the transistor.

Step 2. Mount the transistor using the new compression washer. Do not solder leads at this time. Tighten the transistor mounting screw to 6 inch-pounds.

NOTE

Do not damage the transistor by over tightening the mounting screw. If no accurate method of measuring torque is available, tighten the mounting screw until it just "touches" the compression washer. Then turn the mounting screw 1/4 turn more.

Step 3. Solder transistor leads to printed circuit board.

RECEIVER INTERCONNECT BOARD

FUNCTION --

Interconnects various receiver circuit boards to the unified chassis interconnect board. Model differences are primarily rf filtering.

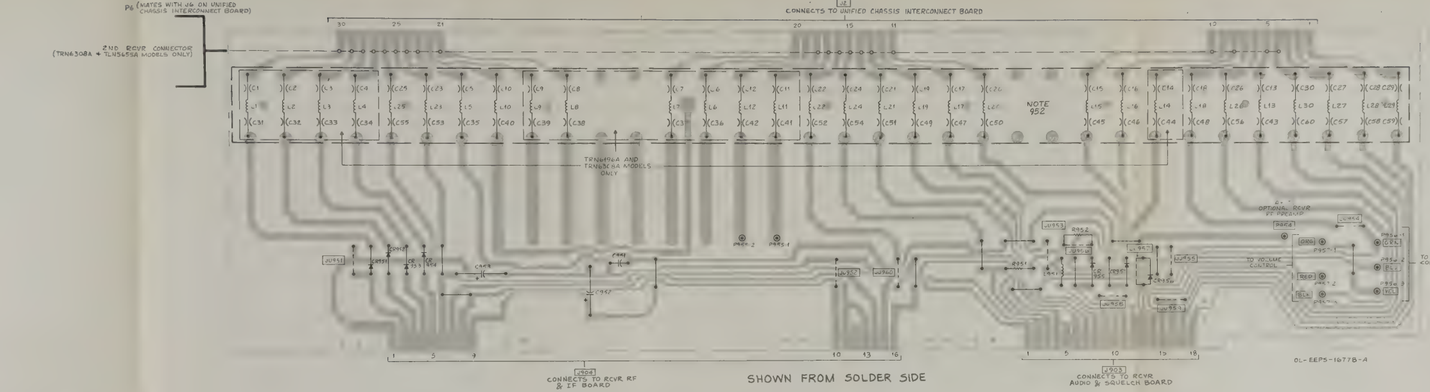
PARTS LIST

NOTE
This parts list covers five models of the Receiver Interconnect Board. Where differences exist, the model number of the applicable unit is given in the Description column.

TLN5646A TLN5648A/TLN5655A/TRN6196A/TRN6308A Receiver Interconnect Board — PL-3435-O

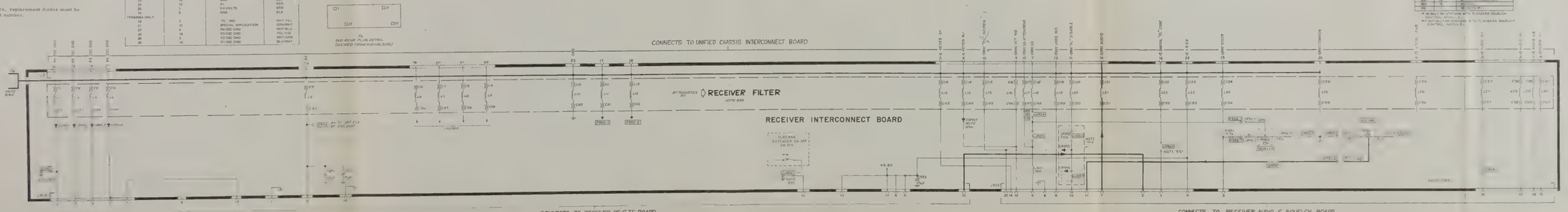
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C1 thru 4, 6 thru 9, 11, 12, 14, 31 thru 34, 36 thru 39, 41, 42, 44	23-861219	CAPACITOR, fixed: 1000 pF +100-0%, 500 V (TRN6196A & TRN6308A)
C5, 10, 13, 35 thru 40, 43, 45 thru 60	21-861219	1000 pF +100-0%, 500 V (TLN5646A, TRN6196A, & TRN6308A)
C951	21-824282D19	.01 uF +80-20%, 200 V
C952, 953	23-847826D09	15 uF ±20%, 20 V
CR951 thru 954, 957	48-823922D03	DIODE, (SEE NOTE) silicon
L1 thru 4, 6 thru 9, 11, 12, 14	24-839H18D1	COIL, rf: 3 turns; coded brown (TRN6196A & TRN6308A)
L5, 10, 13, 22, 23, 27 thru 30	24-83977D01	1-1/2 turns (TLN5646A, TRN6196A, & TRN6308A)
L15 thru 21, 24, 25, 26	24-839H3D1	3 turns, coded brown (TLN5646A, TRN6196A & TRN6308A)
L901	24-82549D03	1000 uH
P6	--	CONNECTOR, plug (TLN5655A) includes:
	14-84556B01	HOUSING, connector
	9-84151B03	CONTACT, receptacle, 14 req'd.
	--	(TRN6308) includes:
	14-84556B01	HOUSING, connector
	9-84151B03	CONTACT, receptacle, 20 req'd.
	6-124C61	RESISTOR, fixed: 2.2k ±10%, 1/4 W
NON-REFERENCED ITEMS		
	7-8262A01	BRACKET, filter
	14-8282D01	INSULATOR (TLN5648A & TLN5655)

NOTE:
For optimum performance, replacement diodes must be ordered by Motorola part number.


P6 (MATES WITH J6 ON UNIFIED CHASSIS INTERCONNECT BOARD)
2ND. RCVR. CONNECTOR (TRN6308A & TLN5655A MODELS ONLY)
J6 CONNECTS TO UNIFIED CHASSIS INTERCONNECT BOARD
TRN6196A AND TRN6308A MODELS ONLY
NOTE 952
TO SQUELCH CONTROL
OPTIONAL RCVR 2ND LO PICKUP
J904 CONNECTS TO RCVR RF & IF BOARD
SHOWN FROM SOLDER SIDE
J903 CONNECTS TO RCVR AUDIO & SQUELCH BOARD
OL-EEPS-1077B-A

2ND RCVR CONNECTIONS

RCVR INTERCONN. BRD. (J1 PIN NO.)	2ND RCVR PLUG (J PIN NO.)	FUNCTION	WIRE COLOR
4	21	AUDIO A-	VIOLET
5	22	AUDIO A+	GRY
6	23	KEYED A+	GRN
11	11	TPL DISABLE	YEL
13	6	R2 SQ CONTROL	ORG
14	18	R2 AUDIO INPUT	WHT/BRN
15	20	TPL TONE OUT	WHT/RED
17	10	TPL TONE IN	WHT/BLK
18	13	SPECIAL APPLICATION	RED/WHT
19	3	SPECIAL APPLICATION	YEL/GRN
23	15	GND	BLK
24	12	8V	BRN
25	5	5.6 VOLTS	BRN
26	7	GND	BLK
TRN6308A ONLY			
18	7	TPL IND	WHT/YEL
19	17	SPECIAL APPLICATION	WHT/GRN
27	19	R4 DISC GND	WHT/BLU
28	16	R3 DISC GND	YEL/VIO
29	2	R2 DISC GND	WHT/GRN
30	14	R1 DISC GND	BLU/WHT


CONNECTS TO UNIFIED CHASSIS INTERCONNECT BOARD
RECEIVER FILTER
RECEIVER INTERCONNECT BOARD
TLN5648A EXTENDED CW OPT SW 5014
NOTE 955
49.6V
CONNECTS TO RECEIVER RF & IF BOARD
CONNECTS TO RECEIVER AUDIO & SQUELCH BOARD

JUMPER/CHART

JUMPER	STATUS	FUNCTION
W1		SEE NOTE W1
W2	IN	SPECIAL APPLICATION
W3	OUT*	R1 DISC ATTENUATE (TRMT)
W4	OUT	R2 DISC ATTENUATE
W5	IN	SPECIAL APPLICATION
W6	IN	SPECIAL APPLICATION
W7	IN	SPECIAL APPLICATION
W8	IN	SPECIAL APPLICATION
W9	IN	SPECIAL APPLICATION

* W3 OUT ON STATIONS W/ TLN5648A SQUELCH CONTROL MODULES.
** W4 OUT ON STATIONS W/ TLN5648A SQUELCH CONTROL MODULES.

NOTES

W1 - JUMPER IS OUT FOR DIGITAL "PL" REPEATER STATIONS AND FULL DUPLEX DIGITAL "PL" BASE STATIONS.

W2 - FILTERING COMPONENTS ARE USED ONLY WITH THE TLN6886A, TLN6886A, TRN6196A AND TRN6308A MODELS. THE TRN6196A AND TRN6308A MODELS USE ALL FILTERING COMPONENTS (C1 -C58 AND L1-L30). THE TLN6886A MODEL USES ALL FILTERING COMPONENTS EXCEPT AS FOLLOWS:

THE TLN6886A MODEL USES ALL FILTERING COMPONENTS EXCEPT AS FOLLOWS

CAPACITORS C1 -4, C6-9, C11, C13, C22, C24, C26, C28, C34, C36, C38, C41, C54, C56, C58, C60
CHOKES L1, L3, L5-L8, L11, L22, L24, L26, L28, L30

THE TLN6886A MODEL DOES NOT USE ANY OF THESE FILTERING COMPONENTS BUT INCORPORATES THINN PLATING INSTEAD. PLATING IS NOT SHOWN ON SCHEMATIC.

W3 - JUMPER IS OUT ON SINGLE FREQUENCY RECEIVERS ONLY. MULTIFREQUENCY CHANNEL ELEMENTS ARE SHIPPED WITH JUMPER IN.

W4 - AN OPTIONAL MODE OF RECEIVER OPERATION WHEN A TPL CODE IS RECEIVED AND THE CARRIER SQUELCH IS OPEN, THE TPL DECODER OUTPUT IS MUTED. THIS MODE IS ACTIVATED BY REMOVING JUMPER W4. CODE SQUELCH IS ADJUSTABLE AND IS ACTIVATED BY CARRIER SQUELCH. IN THIS MODE THE RECEIVER AUDIO CHANNEL IS ACTIVATED WHEN A TPL CODE IS RECEIVED AND THE CARRIER SQUELCH IS OPEN. THE CARRIER SQUELCH MUST BE OPEN BEFORE ACTIVATED CODE SQUELCH OPERATION IS ADJUSTABLE AND SHOULD BE DONE BY THE CONTROL ONLY FACTORY IN THE SOLDERING OF RECEIVER AUDIO. THE OPERATION LOSS BY 60 DB DESTROYED AS A MINIMUM SENSITIVITY. TPL AND SQUELCH DENOTES BOTH PL CODE SQUELCH AND CARRIER SQUELCH. CARRIER SQUELCH MUST BE ADJUSTED FIRST. SEE SERVICE MANUAL FOR ADJUSTMENT PROCEDURE.

W5 - TWO RELAY STATIONS - ONE TYPE/MODEL VERSION BOARD TO INTERCONNECT THE 2ND RECVR TO THE UNIFIED CHASSIS INTERCONNECT BOARD. THIS VERSION BOARD DOES NOT PLUG DIRECTLY INTO THE UNIFIED CHASSIS INTERCONNECT BOARD BUT IS INTERCONNECTED VIA PL6 CONNECTED TO THE SOLR INTERCONNECT BOARD J 40 AS DETAILED IN THE 2ND RCVR CONNECTION TABLE.

W6 - CYRET RECEIVERS ONLY. NOTE FOR REPEATER OPERATION.

ESCRIPTION
.0%; 200 V
%; 25 V
%; 100 V
0%; 200 V
.0%; 200 V
NP0
20%; 200 V
·20%; 200 V
0%; 200 V
)0-20%; 75 V
P0
·F; NP0
·F; NP0
80-20%; 200 V
)UCTOR DEVICE,
EE NOTE I)
n
ot carrier type
'ED CIRCUIT:
8
7
OR, receptacle:
axial; miniature type
'2 turns, tapped at
.s; includes tuning
2 turns; includes
·e
2 turns, tapped at
.s; includes tuning
2 turns, tapped at
.s; includes tuning core
/2 turns; includes
·e
urns; includes tuning
·2/3 turns; includes
·e
D
ioke
choke
/2 turns
D
uH; coded VIO
uH; shielded; coded
-BRN-BLK-BLK-GOLD
uH; shielded; coded
·GOLD-GRAY-GOLD
uH; coded VIO
uH; shielded; coded
·GOLD-GRAY-GOLD
uH; coded VIO
er ferrite bead; coded
2 uH (shld.) coded
D-GOLD-RED-GOLD
TOR, plug:
xial; miniature type
OR: (SEE NOTE I)
oe M9658
oe M9756
M9642
OR, plug:
nce only)
, fixed: ±10%; 1/4 W;
erwise stated

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R107	6-10401A13	33 ±5%
R108	6-129862	150
R109	6-128685	22k
R110	6-129231	3.3k
R111	6-129269	1.8k
R112	6-124A09	22 ±5%
R113	6-129862	150
R114	6-129755	10
R115L	6-10401C87	39k
R115M, H, HH	6-127807	33k
R116L	6-10401C57	2.2k
R116M, H, HH	6-127803	1.5k
R117	6-129224	82
R118L	6-10401C59	2.7k
R118M, H, HH	6-127803	1.5k
R120, 121		NOT USED
R123	6-129667	22k ±5%
R124	6-129233	47
R125	6-129667	22k ±5%
R126	6-131289	910 ±5%
R127	6-129667	22k ±5%
R128	6-129237	6.8k ±5%
R129	6-129982	5.6k ±5%
R130	6-131377	15
R131	6-129236	15k ±5%
R132	6-129667	22k ±5%
R133	6-131289	910 ±5%
R134	6-129667	22k ±5%
R135	6-129668	10k ±5%
R136	6-129755	10
R137	6-124C86	36k
R138	6-127803	1.5k
R139	6-10401A76	13k ±5%
R140	6S124A76	13k ±5%
R141	6-127802	1k
R142	6-129226	100k
R143	6-128902	47k
R144	6-10401C81	22k
*R145	6-124C89	47k
R146	6-124C69	6.8k
R147	6-124C89	47k
		CRYSTAL UNIT, quartz 11.7 MHz
Y101	48-84755E01	i-f filter
*Y102	48-84755E01	i-f filter
	or 48-84755E02	i-f filter
*Y103, 104	48-84755E01	i-f filter
	or 48-84755E03	i-f filter
Y105	48-84754E01	discriminator
		*When replacing Y102, Y103 or Y104, order Part No. 48-84755E01 only.

TLE8340A 2-Receiver Coupler Kit PL-3432-O

R1	6-124A25	RESISTOR, fixed: 100 ±5%; 1/4 W
W2, 3	30-83233K01	CABLE, RF: coaxial (solid)
W4	1-80737B77	includes; 30-83794C01 CABLE, coaxial (4"); 9-84968D01 JACK, bulkhead; 28-82331G01 CONNECTOR, phone type
W5	1-80775B69	includes; 30-84173E01 CABLE, coaxial (12") and (2) 28-82331G02 CONNECTOR, phono type
W6	1-80775B70	includes; 30-84173E01 CABLE, coaxial (11") and (2) 28-84967D01 CONNECTOR, BNC type
NON-REFERENCED ITEM		
	1-80775B68	BRACKET ASSEMBLY: includes 7-84131G01 BRACKET and (3) 9-83663C01 CONNECTOR, phono type

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PREAMPLIFIER

TLE8191A Preamplifier (406-450 MHz)
TLE8192A Preamplifier (450-512 MHz) PL-2693-O

C1, 2	20-83693H03 or20-83693H01	CAPACITOR, variable: (includes standard tuning "piston"); 0.9 - 9.0 pF (406-450 MHz) 0.8 - 6.0 pF (450-512 MHz) (NOTE: Also order 76-84425B01 PISTON, tuning;)(special: SEE NOTE II)
C3, 4	21-861441	CAPACITOR, fixed: 500 pF ±10%; 75 V; N4700
C5	21-861219	.001 uF +100-0%; 500 V; coded RED
C6	23-84762H04	2.2 uF ±20%; 25 V
J1, 2	9-84135B01	CONNECTOR, receptacle: female; coaxial; miniature type
L1	47-84330B01	COIL, RF: (straight rod; 1.75" long)
L2, 3	24-800484	choke; 0.31 uH
L4	47-84330B03	(straight rod; 2.19" long)
P2, 104	28-84282D01	CONNECTOR, plug: male; coaxial; miniature type
Q1	48-869533	TRANSISTOR: (SEE NOTE I) field-effect "N Channel"; type M9533; does not include 42-83660C01 CLIP, transistor retaining
R1	6-10401C25	RESISTOR, fixed: 100 ±10%; 1/4 W
R2	6-185B73	330 ±10%; 1/8 W
R3	6-10401C17	47 ±10%; 1/4 W
W1	1-80739B37	LINE, RF transmission: includes P2, P104 and 30-83794C01 CABLE, RF: coaxial; 6-1/2" length required

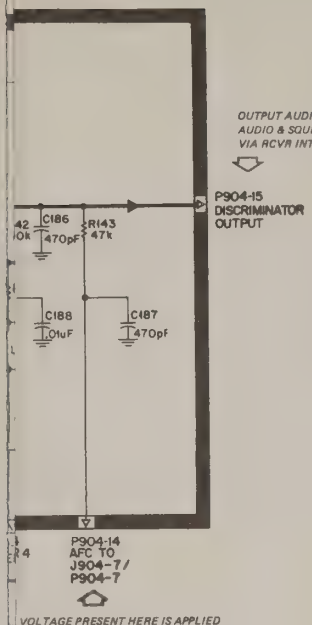
RECEIVER RF & IF MODEL COMPLEMENT

RF PREAMPLIFIER (OPTIONAL)
MODEL TLE8190A SERIES

RF DECK
MODEL TLE8020A SERIES

RF & IF BOARD
MODEL TLE8030B SERIES

2-RECEIVER COUPLER
MODEL TLN8340A SERIES


OUTPUT AUDIO IS APPLIED TO AUDIO & SQUELCH BOARD (PIN 2) VIA RCVR INTERCONNECT BOARD
P904-15 DISCRIMINATOR OUTPUT
C186 470pF
R143 47k
C188 .01uF
C187 470pF
P904-14 AFC TO J904-7/ P904-7
VOLTAGE PRESENT HERE IS APPLIED K TO P904-7 ON THIS BOARD VIA EIVER INTERCONNECT BOARD.

FUNCTION --

Produce low level audio output from received modulated rf signal.

RECEIVER RF & IF NOTES

101. *FREQUENCY CALCULATION:*

$f_c = 24\, f_o + 11.7$ MHz or $f_c = 24\, f_o + 11.8$ MHz

$f_o = \frac{f_c - 11.7\text{ MHz}}{24}$ or $f_o = \frac{f_c - 11.8\text{ MHz}}{24}$

WHERE: f_c = CARRIER FREQUENCY
f_o = CHANNEL ELEMENT FREQUENCY
11.7 MHz = MIXER OUTPUT FREQUENCY (I–F)
11.8 MHz = MIXER OUTPUT FREQUENCY (I–F SHIFTED)
24 = CHANNEL ELEMENT HARMONIC

THE RECEIVER I–F IS FACTORY SHIFTED FROM 11.7 MHz TO 11.8 MHz WHEN THE DIFFERENCE BETWEEN RECEIVED CARRIER (CHANNEL SPACING) FREQUENCIES IS:

11.7 MHz ± 25 kHz
5.85 MHz ± 25 kHz
3.90 MHz ± 25 kHz
2.925 MHz ± 25 kHz

102. *DASHED LINES REPRESENT SHIELDING.*
103. *INDEX DOT ON Y105 CRYSTAL CAN INDICATES PHYSICAL ORIENTATION REQUIRED.*
104. *UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS. RESISTOR VALUES ARE IN OHMS.*
105. *RF VOLTAGES TAKEN WITH MOTOROLA SOLID–STATE DC MULTIMETER WITH PLUG–IN RF PROBE.*
106. *UNLESS OTHERWISE STATED, VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES MEASURED WITH AN 11 MEGOHM INPUT RESISTANCE VOLTMETER IN RESPECT TO CHASSIS GROUND.*
107. *DC VOLTAGE IS FUNCTION OF SIGNAL LEVEL.*
108. *CIRCUITRY ASSOCIATED WITH CHANNEL ELEMENTS F5–F12 (CAPACITORS AND CHANNEL ELEMENT SOCKETS) ARE PRESENT ON THIS BOARD BUT NOT FUNCTIONAL.*
109. *JU101 IS ALWAYS CUT. L117 IS PRESENT ON THE CIRCUIT BOARD BUT NOT FUNCTIONAL IN THIS APPLICATION.*
110. *R144 MUST BE USED WITH RF DECK MODELS TLE8023A, TLE8024A AND TLE8025A SUFFIX –1 OR LATER, AND WITH TLE8021A (NO SUFFIX).*
111. *VALUE DEPENDS ON FREQUENCY RANGE OF RADIO SET. SEE COMPONENT VALUE TABLE ON THIS PAGE.*
112. *THE TWO–RECEIVER COUPLER MOUNTS IN THE RECEIVER SECTION OF THE UNIFIED CHASSIS AND MAY OR MAY NOT BE USED WITH OPTIONAL RF PREAMPLIFIERS. WITH NO PREAMPLIFIER, THE COUPLER CONNECTS BETWEEN THE ANTENNA SWITCH AND BOTH RECEIVERS. WITH ONE PREAMPLIFIER, THE COUPLER CONNECTS BETWEEN THE PREAMPLIFIER AND BOTH RECEIVERS. WITH TWO PREAMPLIFIERS, THE COUPLER CONNECTS BETWEEN THE ANTENNA SWITCH AND BOTH PREAMPLIFIERS. THE TWO–RECEIVER IS NOT USED IN TAC APPLICATIONS.*

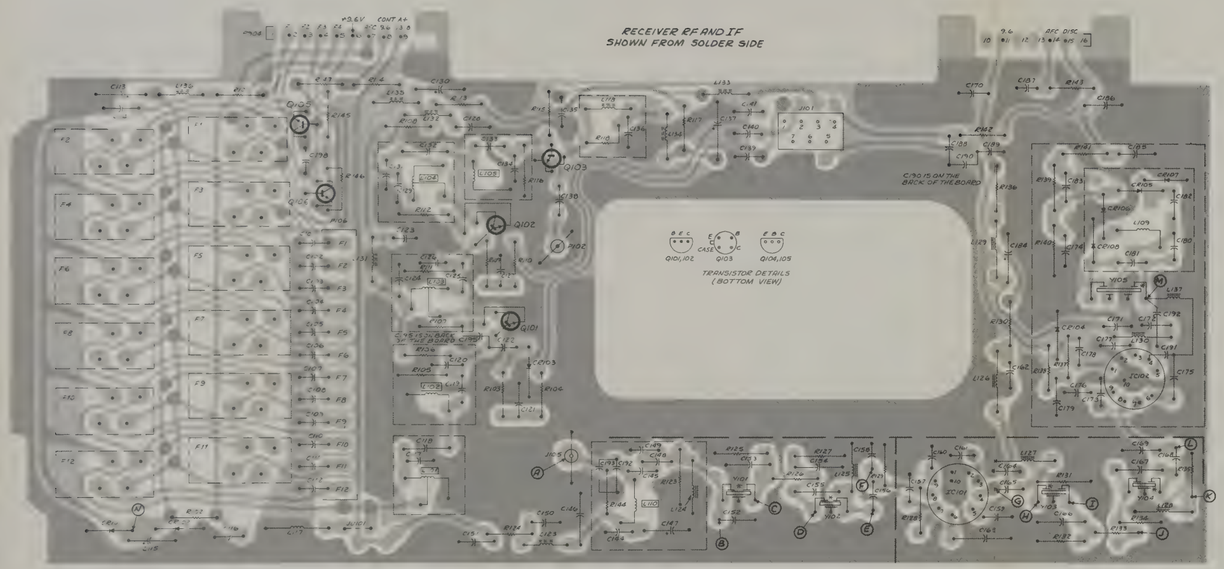
LEGEND.

START - *CIRCUIT THEORY MOST EASILY UNDERSTOOD BY BEGINNING AT THIS POINT AND FOLLOWING SIGNAL FLOW.*

= *THEORY OF OPERATION DATA*

= *MAINTENANCE DATA*

= *PRIMARY SIGNAL FLOW*



RF DECK

TLE8021A (406-420 MHz)
TLE8023A (450-494 MHz)
TLE8025A (494-512 MHz)

LEGEND:
L = 406-420 MHz
M = 450-470 MHz
H = 470-494 MHz
HH = 494-512 MHz

PL-1878-E

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C142	21-s604z-	
C143	21-s5x0C01	
C196	21-b2555D2e	
J102, 103, 104	9-84335B02	
L106L	24-84769E12	
L106M, H	24-84734E01	
L106HH	1-80752B34	
L107L	24-84769E15	
L107M, H, HH	24-84769E16	
L108L	24-84769E12	
L108M, H, HH	24-84734E01	
L111L	24-84751E09	
L111M	24-s6434E01	
L111H	24-s6434E04	
L111HH	24-s6434E07	
L112L-112-, L112M-115M	24-s4731E10	
L112H thru 115H	24-s4731E05	
L112HH thru 115HH	24-s4731E06	
L116L	24-84751E09	
L116M	24-s4734E01	
L116H	24-84734E06	
L116HH	24-84734E07	
L122L	24-s6434E04	
L122M, H, HH	24-s4w4J01	
L138	24-84763H04	
R119-, R119M, H, HH	6-10401C45	
P105	28-84282D01	
Q104L, M, H, HH	48-869839	

CAPACITOR, fixed:
15 pF ±5%, 500 V; NPO
.001 uF ±10%, 100 V
10 pF ±0.25 pF; 500 V; NPO

CONNECTOR, receptacle:
female; coaxial; miniature type

COIL, RF:
(coded RED, RED); 6-5/8 turns, tapped
(coded YEL, YEL); 6-1/8 turns, tapped
(coded VIOLET-VIOLET); 5-7/8 turns; tapped
(coded GRN, GRN); 6-5/8 turns
(coded BLU, BLU); 6-1/8 turns
(coded RED, RED); 6-5/8 turns, tapped
(coded YEL, YEL); 6-1/8 turns, tapped
4-1/2 turns
4 turns, tapped
3-3/4 turns, tapped
3-9/16 turns, tapped
4-1/2 turns +
4 turns
4-1/2 turns
4 turns, tapped
3-3/4 turns, tapped
3-9/16 turns, tapped
YEL: 7-3/2 turns
BRN: 1-1/2 turns
choke; 0.29 uH

RESISTOR, fixed:
680 ±10%; 1/4 W
560 ±10%; 1/4 W

CONNECTOR, plug:
male; coaxial; miniature type

TRANSISTOR: (SEE NOTE)

field-effect; N-channel MMBF

NON REFERENCED ITEMS

	1-80745B84	MIXER BOARD: includes reference parts C142, C143, C196, L122, Q104, R119
	3-138841	SCREW, tuning: used with L106, L107, L108
	2-84731E01	NUT, tensioning: "star" type; used with L106, L107, L108
	3-139002	SCREW, tuning: used with L111 thru 116
	2-84733E01	NUT, tensioning: "star" type; used with L111 thru 116

RECEIVER RF & IF BOARD

TLE8031A/B (406-420 MHz)
TLE8032A/B (450-494 MHz)
TLE8033A/B (494-512 MHz)

LEGEND:
L = 406-420 MHz
M = 450-470 MHz
H = 470-494 MHz
HH = 494-512 MHz
* = For B Suffix boards only.

PL-1879-E

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C101 thru 112	21-84248B59	CAPACITOR, fixed: pF; ±5%, 500 V; unless otherwise stated .01 uF +80-20%, 200 V
C113	23-84762H01	10 uF ±10%, 20 V
C114	21-84248B59	.01 uF +80-20%, 200 V
C115	8-83813H11	0.22 uF ±10%; 75 V
C116	21-84762H01	10 uF ±10%, 20 V
C117	21-s5x0C01	470 ±10%
C117L	21-84248B51	27; N330
C117M, H	21-82133G44	18; N330
C117HH	21-83400D01	15; N330
C118L	21-82450B46	0.62; coded BLU-RED-GRAY-GOLD
C118M, H, HH	21-82450B29	0.51; coded GRN-BRN-GRAY-GOLD
C119L	21-83406D06	39; N220
C119M, MO, H, HH	21-84493B44	33; 250 V; N150
C120	21-82610C44	100; 100 V; N720
C121	21-84248B59	.01 uF +80-20%; 200 V
C122	21-857336	2.40.25 pF; NP0
C124	21-82187B10	220 ±10%
C204	21-82187B13	.0015 uF ±10%; 100 V
C125L	21-82133G73	12; N150
C126M, H, HH	21-858912	8 ±0.25 pF; N150
C126L-	21-84493B44	33; N150
C126M, MO, H, HH	21-82610G14	30; 200 V; N150
C127	21-82428B59	.01 uF +80-20%; 200 V
C128	21-831125	100 ±10%; 300 V; N750
C129	21-82187B08	220 ±10%
C130	23-84762H04	2.2 uF ±20%; 25 V
C131L	21-83406D51	3 ±0.25 pF; NP0
C131M, H	21-857336	2.0 ±.25 pF; NP0
C131HH	21-868487	1.5 ±0.25 pF; NP0
C132	21-82450B35	0.2 ±10%; coded RED-BLK-GRAY-SILVER
C133L	21-82133G18	6 ±0.25 pF; N470
C133M, H, HH	21-849320	4 ±0.25 pF; N470
C134L	21-84493B43	8 ±0.25 pF; N470
C134M, H, HH	21-82428B31	5 ±0.25 pF; N470
C135	21-82428B59	.01 uF +80-20%; 200 V
C136L	21-82610C07	51; 200 V; N150
C136M, H, HH	21-82610G03	47; 200 V; N220
C137	23-84762H04	2.2 uF +20% 25 V
C138	21-8355B30	2.7 +0.1 pF; NP0
C139, 140	21-82428B59	.01 uF +80-20% 200 V
C141	21-82187B17	820 ±10%
C144	21-82610C03	47; 200 V; N220
C145	21-82133G01	10; NP0
C146	8-82905G04	.068 uF ±10%; 50 V
C147	23-84762H04	2.2 uF +20% 25 V
C148, 149	21-82133G01	10; NP0
C150, 151	21-82428B59	.01 uF +80-20% 200 V
C152	21-82133G33	6.8 +0.5 pF; NP0
C153	21-82450B04	0.3 ±10%; coded ORG-BLK-GRAY-SILVER
C154	21-82450B35	0.2 ±10%; coded RED-BLK-GRAY-SILVER
C155	21-82450B07	0.39; coded ORG-WHT-GRAY-GOLD
C156	21-82610C43	62; 100 V; NP0
C157	21-82428B59	.01 uF +80-20% 200 V
C158	21-82133G29	18; NP0
C159, 160, 161	21-82428B57	.0033 uF ±10% 200 V
C162	21-82428B59	.01 uF +80-20% 200 V
C163	8-83813H05	.068 uF ±10% 100 V
C164	21-82610C84	39; 650 V; NP0
C165	21-8355B03	33; NP0
C166	21-82450B33	0.56; coded GRN-BLU-GRAY-GOLD
C167	21-82450B07	0.39; coded ORG-WHT-GRAY-GOLD
C168	21-8355B09	33; NP0
C169	21-82610C49	40; 100 V; NP0
C170	21-82428B57	.0033 uF ±10%; 200 V
C171, 172	21-82428B59	.01 uF +80-20% 200 V

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C173	21-82428B57	.0033 uF +10% 200 V
C174	23-8476J04	2.2 uF +20% 25 V
C175	8-83813H06	0.1 uF ±10% 100 V
C176, 177	21-82428B57	.0033 uF ±10% 200 V
C178	21-82187B08	220 ±10%
C179	21-82428B57	.0033 uF ±10% 200 V
C180, 181	21-82187B03	100; 200 V; N9?0
C182	21-82428B59	.01 uF +80-20% 200 V
C183, 184	21-82187B17	470 ±10%
C185, 186, 187	21-82187B39	470 ±10%
C188	21-82428B59	.01 uF +80-20% 200 V
C189	21-82428B57	.0033 uF +10% 200 V
C190	21-84493B24	40; N150
C191	21-84510CC73	51; N150
C192	21-863443-	.01 uF +100-20% 75 V
C193, 194	21-840848	6 +.5 pF; NP0
C195	21-82355B26	10 +0.25 pF; NP0
C196	21-82355B26	10 +0.25 pF; NP0
C197	21-82428B59	0.01 uF +80-20% 200 V
CR101, 102	48-8219D13	SEMICONDUCTOR DEVICE, diode: (SEE NOTE 1) silicon
CR103, 104	48-8219G01	silicon;
CR105 thru 108	48-8461A01	silicon; hot carrier type
IC101	51-8429A38	INTEGRATED CIRCUIT
IC102	51-8429A07	
L101	24-84972A15	2 turns, tapped at miniature type
L101	24-84972A16	2 turns; includes
L161	24-84972A17	2 turns, tapped at includes tuning
L164	24-83855D27	2 turns, tapped at 1-5/8 turns; includes tuning core
L165	24-83856C05	GRN; 1-1/2 turns; includes tuning core
L166	24-83879G64	YEL; 66 turns; includes tuning core
L182	24-84258B06	BLU; 16 +2/3 turns; includes tuning core
L1171 L1181,H L1191 L1201	24-82542E01 24-82542E11	NOT USED
L1205, 121	24-82712H97	NOT USED choke; 10 uH; coded YIO
L1255	24-82549D25	choke; 10 uH, shielded, coded (SILVER) - BRN-BLK BLK-GOLD
L126	24-84250D02	choke; 6.8 uH, shielded; coded WHT-BLU-GOLD GRAY-GOLD
L127	24-82723H07	choke; 10 uH; coded YIO
L127, 128	24-84760D02	choke; 6.8 uH; shielded; coded WHT-BLU-GOLD-GRAY-GOLD
L129, 130	24-82723H07	choke; 10 uH; coded YIO
L131 thru 136	24-83961B01	3 turns over ferrite bead; coded BRN
L137	24-84250D03	choke; 2.0 uH (stnd.); coded RED-BLK-GOLD-GOLD
P102	28-84227B01	CONNECTOR, receptacle: female; 14 pin
Q101, 102	48-869658	
Q103	48-86976a	
Q104, 105	48-869842	
P105		
P101	6-129755	
R102	6-127807	
R103	6-129230	
R104	6-129231	
R105	6-129269	
R106	6-127806	

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C-	6-10401A13	
R-	6-129862	
R-	6-128635	
R-	6-129231	
R-	6-129269	
C-	6-124A05	
R-	6-129862	
R-	6-129755	
C-	6-10401C87	
R-	6-129805	
C-	6-10401C1*	
R-	6-127863	
R-	6-129224	
C-	6-10401C59	
R-	6-127803	
R-	6-129067	
R-	6-129231	
R-	6-129767	
R-	6-131289	
R-	6-129767	
R-	6-129237	
R-	6-129982	
R-	6-131277	
R-	6-129236	
R-	6-129867	
R-	6-131289	
R-	6-129667	
R-	6-129868	
R-	6-129755	
R-	6-124C96	
R-	6-127801	
R-	6-10401A76	
R-	6-5124A76	
R-	6-127802	
R-	6-129826	
R-	6-128962	
C-	6-10401C81	
R-	6-124C69	
R-	6-124C69	
R-	6-124C69	
Y101		
*Y103, 104	48-84755E01	CRYSTAL UNIT, quartz 11.7 MHz: (Y Y103)
	48-84755E01	(Y Y104)
	or 48-84755E05	(-1 filter
	48-84755E01	(-1 filter
	or 48-84755E05	(-1 filter
	48 84754E01	discriminator

*When replacing Y102, Y103 or Y104, order Part No 48-84755E01 only

TLE8140A 2-Receiver Coupler Kit

PL-3412-O

R-	6-124A25	RESISTOR, fixed: 100 ±5%, 1/4 W
C-	Y-s3231C01	CABLE, RF: coaxial; (solid:
J-	1-80737B77	1 ea/4	9-44w4w001 JACK; bulkhead, 28-82331C01 CONNECTOR, phone type
J-	1-80775B69	includes: 30-84734E01 CABLE, coaxial (12) and (2- 2e-82331C02 CONNECTOR, phone type
J-	1-80775B70	includes: 30-84734E01 CABLE, coaxial (11) and (2- 28-s4w7D01 CONNECTOR, BNC type
		NON-REFERENCED ITEM
	1-80775B68	BRACKET ASSEMBLY, includes 7-84131C01 BRACKET and (1) 9-84w3C01 CONNECTOR, phone type

PREAMPLIFIER

TLE8192A Preamplifier (450-512 M

C-		
R-		
C-		
R-		
C-		
R-		

RECEIVER RF & IF MODEL COMPLEMENT

RF PREAMPLIFIER (OPTIONAL)
MODEL TLE9190A SERIES

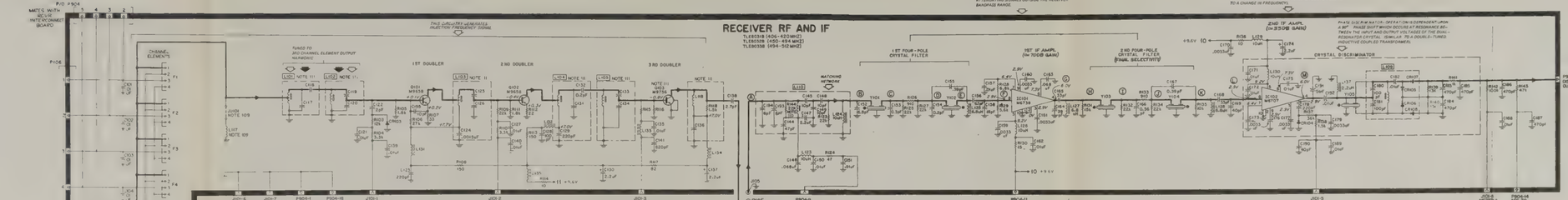
RF DECK
MODEL TLE8020A SERIES

RF & IF BOARD
MODEL TLE8030B SERIES

2-RECEIVER COUPLER
MODEL TLN8340A SERIES

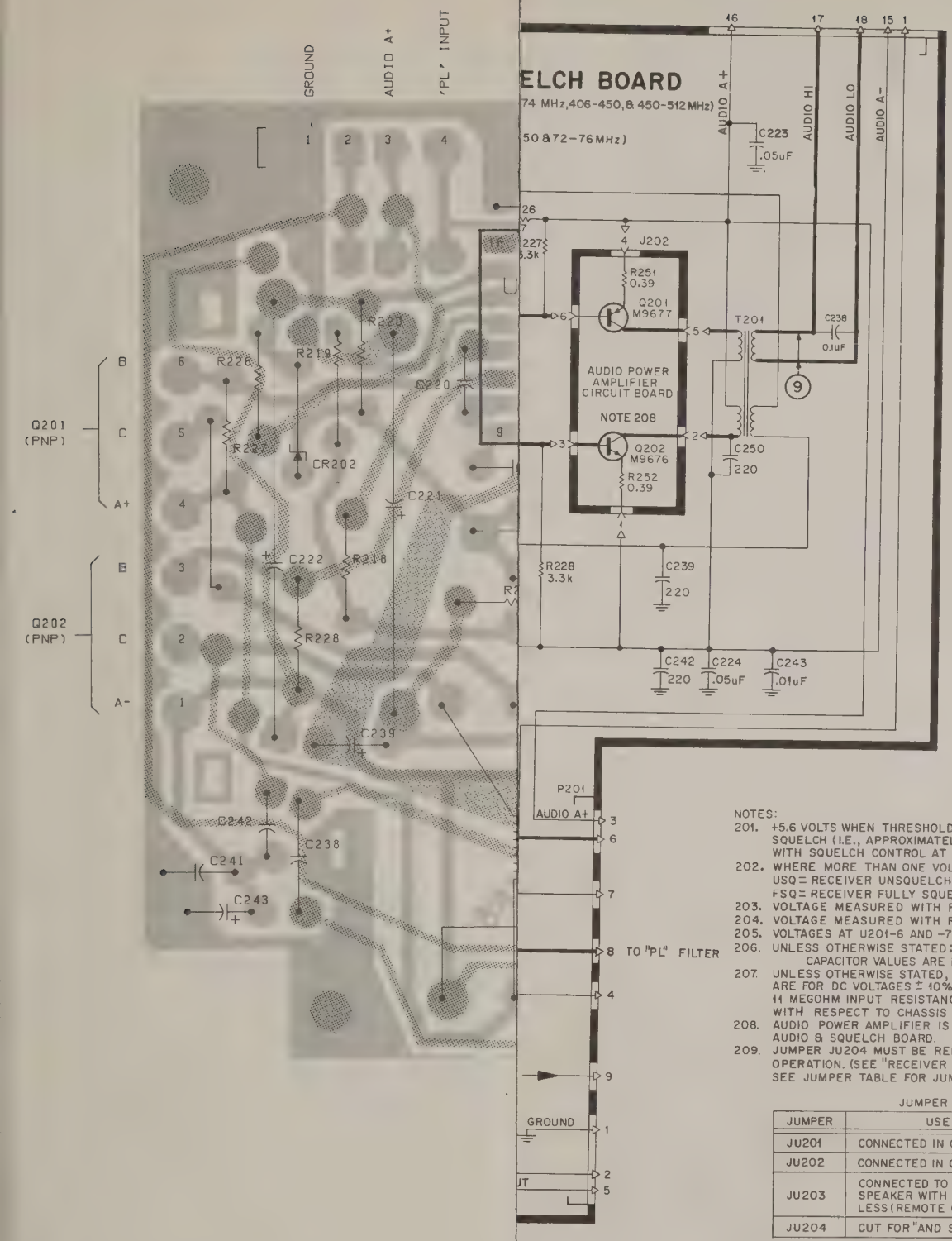
FUNCTION --

Produce low level audio output from received modulated rf signal.


RECEIVER RF AND IF
TLE8030B (406-420MHZ)
TLE8030B (450-494 MHZ)
TLE8030B (494-512MHZ)
1ST DOUBLER
2ND DOUBLER
3RD DOUBLER
1ST FOUR-POLE CRYSTAL FILTER
2ND FOUR-POLE CRYSTAL FILTER (FINAL SELECTIVITY)
1ST IF AMPL (to 100B GAIN)
2ND IF AMPL (to 35DB GAIN)
CRYSTAL DISCRIMINATOR
MATCHING NETWORK
P/O P804
MATES WITH RECVR INTERCONNECT BOARD
CHANNEL ELEMENTS
OUTPUT AUDIO IS APPLIED TO AUDIO & SQUELCH BOARD (P/O P1) VIA RECVR INTERCONNECT BOARD
P804-15 DISCRIMINATOR OUTPUT
AFC VOLTAGE PRESENT HERE IS APPLIED BACK TO P804-7 ON THIS BOARD VIA RECEIVER INTERCONNECT BOARD
JOG-5 METER 5
JOG-6 METER 6
JOG-4 METER 4
JOG-3 METER 3
JOG-2 METER 2
JOG-1 METER 1
JOG-7 GROUND
P804-8
P804-16
P804-11 +9.6V
P804-15 +8.5V
P804-14 AFC VOLTAGE
P804-7
P804-1
P804-13 DISCRIMINATOR OUTPUT
P/O P804
MATES WITH RECVR INTERCONNECT BOARD
P104
JOG-9 NOTE 109
LIST NOTE 109
NOTE 108
P/O P1
P/O P804
+5.6V
AFC (REFER TO P804-14)
AFC LATCH
P/O J804
NOTE 111
NOTE 110
THIS CIRCUITRY GENERATES INJECTION FREQUENCY SIGNAL
TUNED TO 3RD CHANNEL ELEMENT OUTPUT HARMONIC
Q101 MRF559
Q102 MRF554
Q103 MRF559
Q104 MRF554
Q105 MRF554
Q106 MRF554
Q107 MRF554
Q108 MRF554
Q109 MRF554
Q110 MRF554
Q111 MRF554
Q112 MRF554
Q113 MRF554
Q114 MRF554
Q115 MRF554
Q116 MRF554
Q117 MRF554
Q118 MRF554
Q119 MRF554
Q120 MRF554
Q121 MRF554
Q122 MRF554
Q123 MRF554

Two additional functions that may affect the squelch control logic output are associated with "Private-Line" tone-coded squelch operation. PL disable (U202-14) may be either o ground or open. When an open is present at U202-14 (PL disabled), a received signal with t a PL tone will be heard from the speaker. When at ground potential (PL enabled), the out- carrier squelch switching logic circuit is inhibited. When the proper PL tone is received, 9.5 volts dc from the PL decoder board to U202-8 turns off the squelch control logic circuit ns off the shunt switches and allows a message to be heard. Jumper JU204 is normally in it and is only cut when a field modification is made. The cutting of this jumper and associated ions on the receiver interconnect board will provide "AND-SQUELCH" operation, changing quelch circuitry from fixed sensitivity operation to variable sensitivity operation. Under e of operation, the SQUELCH control will affect the squelch sensitivity.

Audio disabling is performed by shunting the audio circuit to ground through a low impedance path and also by the operation of a series switch in the line driver. When the e shunt switch is turned "on" (U202-7), signals developed across R236 are shunted to ground. vents any signals from being heard at the speaker. Acting in tandem with the first shunt he second shunt switch output is routed to the line driver and enables a set of switches on the boards. This breaks the audio path and prevents audio from appearing on the 600-ohm



NOTES:

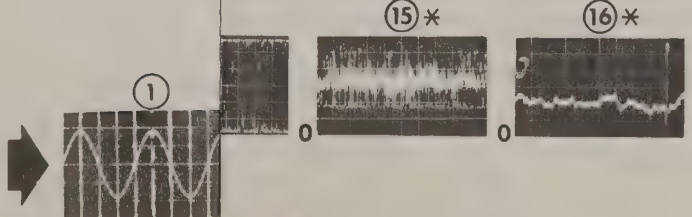
201. +5.6 VOLTS WHEN THRESHOLD SIGNAL JUST OPENS SQUELCH (I.E., APPROXIMATELY 6 dB QUIETING SIGNAL WITH SQUELCH CONTROL AT THRESHOLD).
202. WHERE MORE THAN ONE VOLTAGE READING APPEARS: USQ= RECEIVER UNSQUELCHED FSQ= RECEIVER FULLY SQUELCHED
203. VOLTAGE MEASURED WITH RESPECT TO A-.
204. VOLTAGE MEASURED WITH RESPECT TO A+.
205. VOLTAGES AT U201-6 AND -7 MUST BE THE SAME VALUE.
206. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS.
207. UNLESS OTHERWISE STATED, VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES ± 10% MEASURED WITH AN 11 MEGOHM INPUT RESISTANCE VOLTMETER WITH RESPECT TO CHASSIS GROUND.
208. AUDIO POWER AMPLIFIER IS NOT PART OF AUDIO & SQUELCH BOARD.
209. JUMPER JU204 MUST BE REMOVED FOR "AND SQUELCH" OPERATION. (SEE "RECEIVER INTERCONNECT UNIT" SECTION). SEE JUMPER TABLE FOR JUMPER USE.

JUMPER TABLE

JUMPER	USE
JU201	CONNECTED IN CARRIER SQUELCH STATIONS.
JU202	CONNECTED IN CARRIER SQUELCH STATIONS.
JU203	CONNECTED TO PROVIDE 10 WATTS AUDIO AT SPEAKER WITH LINE LEVELS OF -10 dBM OR LESS (REMOTE CONTROL STATIONS ONLY).
JU204	CUT FOR "AND SQUELCH"

AUDIO CIRCUIT OSCILLOSCOPE WAVEFORMS
EN UNDER THE FOLLOWING CONDITIONS.

VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
HORIZONTAL DEFLECTION = .25 msec/DIV
SQUELCH CONTROL FULLY COUNTERCLOCK WISE (OFF). 1000 uV RF SIGNAL INPUT MODULATED WITH 1000 Hz TONE WITH +3 0 kHz DEVIATION.
VOLUME CONTROL SET FOR 9 0 V rms AT LOAD OUTPUT TERMINATED IN 8 OHM LOAD
R203 SET FOR 175 mV AT PIN 7 WITH +5 kHz DEVIATION (1 kHz TONE).



FPS-8804-O

RECEIVER AUDIO & SQUELCH BOARD CIRCUIT DESCRIPTION

1. DESCRIPTION

1.1 The audio and squelch board performs two basic functions -- audio amplification and audio squelching. The first two stages in the audio circuitry amplify the signal from the discriminator and provide the proper frequency response. This signal is routed to the line driver module. The audio returns through a VOLUME control. The remaining stages in the audio circuitry take the signal returning from the line driver and VOLUME control and provide the necessary frequency response at the speaker. These latter stages also provide the driver required by the final audio amplifiers (located on a separate board) for rated power output.

1.2 The squelch circuitry disables the audio path during intervals between received messages. Also, in conjunction with the PL decoder and filter board in a PL station, this circuit provides unsquelching when PL signals are received.

2. FUNCTIONAL OPERATION

2.1 GENERAL

2.1.1 The audio signal from the receiver discriminator is routed to the emitter follower. The emitter follower output is coupled to the SQUELCH control mounted on the receiver chassis and also to the line level potentiometer mounted on the audio & squelch board. The signal from this control is next applied to the preamplifier. If JU201 is cut, the signal is first sent through the PL filter for attenuation of the PL tone. The preamplifier output is coupled off the board to the line driver. Audio returning from the line driver board is coupled through the appropriate VOLUME control to amplifier Q203. After amplification, the signal is applied to the audio amplification circuits. Here, the signal is raised to a level sufficient to drive the audio final amplifier. These are mounted on a separate board which is secured to the chassis to provide "heat-sinking" capability. The output of the audio power amplifiers is applied to an output transformer which drives a speaker.

2.1.2 The signal returned from the SQUELCH control is applied to the squelch section for noise squelch control. Squelch action is achieved by utilizing the inherent characteristic of a discriminator known as noise quieting. An input signal will cause more quieting of noise as the signal level is increased. When a desired level of noise quieting is reached, as determined by the squelch circuitry and the setting of the SQUELCH control, the audio portion of the board and line driver are enabled to allow a message to be heard. The squelch circuit disables the audio circuitry by shunting a point in the audio signal path to ground and also operating a series switch in the audio signal path of the line driver.

2.1.3 Upon completion of a received message, audio shut-off is either immediate or automatically delayed 150 milliseconds, depending upon the signal level of the previously received rf carrier. A strong signal produces the immediate shut-off and prevents an annoying, loud "squelch tail" burst from being heard. Weak signals (signals that produce less than 20 dB noise quieting) produce the long shut-off delay and prevent a message from being chopped under "flutter" conditions. Since the received signal level must be low for the long turn-off delay to occur and the "squelch tail" level is comparable to that of the received signal, the "squelch tail" is not annoying.

2.2 EMITTER FOLLOWER CIRCUIT

2.2.1 The emitter follower circuit provides a low impedance output which isolates the high impedance discriminator output from the following squelch and audio circuitry.

2.2.2 The output of the discriminator is capacitively coupled to the emitter follower input at U201-1 and may consist of noise and audio signals. The output of the emitter follower at U201-2 is routed through C207 to the SQUELCH control and also to the line level control.

2.3 PREAMPLIFIER CIRCUIT

This circuit amplifies the low-level audio signal to provide the drive necessary for proper line driver operation. In addition, a negative feedback network (C208 and C209) provides the necessary frequency response characteristics for phone line operation. In PL stations, jumper JU202 is cut and the negative feedback is provided by C209 only. The network of R210 and C210 provides additional frequency response shaping.

2.4 AMPLIFIER CIRCUIT

Transistor Q203 increases the signal level from the line driver to the level required by the audio amplification circuits. Jumper JU203 is out when the equipment leaves the factory. The gain of Q203 is sufficient to drive the audio amplification circuits if the signal strength from the line driver or squelch gate exceeds -10 dBm. With a signal strength below this level, it is advisable to put in JU203 which increases the gain of Q203. The RC network at the input to this stage provides additional frequency response shaping required at the speaker.

2.5 AUDIO AMPLIFICATION CIRCUIT

2.5.1 The signal from amplifier Q203 is applied to the differential amplifier through capacitors C211 and C213.

2.5.2 The differential amplifier output provides the drive for the complementary amplifier. Resistors R221 and R220 form a voltage divider biasing the differential amplifier at one-half of the supply voltage. Undesirable transient voltages are eliminated by capacitor C212.

2.5.3 Final audio amplification on the audio and squelch board occurs in the complementary amplifier. These stages provide the drive for the audio power amplifiers which are mounted on a separate board. The complementary amplifier emitter resistors (R218 and R219) are not included in U201 because of their high heat dissipation requirements.

2.5.4 Audio returned to the audio and squelch board (from the audio power amplifier transistors) is applied to the output transformer primary windings. This transformer consists of four windings -- two input primaries, an output secondary, and a feedback secondary. The output secondary winding couples audio power to an external 8-ohm speaker which can be driven with up to 10 watts at less than 5% distortion. Negative feedback from the output transformer winding through C216 and across R211 gives 6 dB per octave de-emphasis (roll-off) to the audio which has been pre-emphasized 6 dB per octave in the transmitter. Below 300 Hz, feedback from R213 and across C215 increases giving low frequency de-emphasis. Capacitor C238 rolls off the high frequency gain of the amplifier to prevent high frequency oscillation. Capacitors C223 and C224, C240, C241, and C242 are rf bypass capacitors that shunt stray rf on the audio A+ and audio A- lines to ground.

2.6 NOISE ACTIVATED SQUELCH CIRCUIT

2.6.1 Squelch Input Circuit

2.6.1.1 The input signal from the SQUELCH control may consist of audio and noise. An input shaping network precedes U202 and passes high frequencies while attenuating low frequencies. Allowing the high frequencies to pass eliminates the effect of voice and results in more sensitive threshold squelch action.

2.6.1.2 The first amplifier and limiter is driven into limit by its input signal and prevents audio from squelching (disabling) the audio channel on voice signals. Amplified, limited noise is then passed through a coupling network to the second amplifier. This coupling network is also a high pass filter which further attenuates voice and tone signals to the second amplifier.

2.6.1.3 The second amplifier amplifies the noise signal and applies it through an RC coupling network to the detector. Capacitor C233 and C234 form another high pass filter that attenuates the low frequencies. Capacitor C234 is used to produce a peak-to-peak detector action from the noise detector, and thus generate twice the output voltage of a peak detector. This capacitor does not affect frequency response.

2.6.2 Detector and Switching Circuits

2.6.2.1 The detector output level is a function of received signal strength and the setting of the SQUELCH control. The detector develops the dc output voltage across filter capacitor C235. The lowest dc output voltage corresponds to a no signal input (maximum noise) condition. The output voltage increases as the received rf carrier signal level increases (noise decreases).

2.6.2.2 The primary function of the detector output, however, is the control of shunt switching. This is done by applying the detector output to three squelch control circuits simultaneously:

long "squelch-tail" circuit

long "squelch-tail" defeat switch

carrier squelch switching logic

2.6.2.3 With no received rf carrier signal (maximum noise condition), the long "squelch tail" circuit and long "squelch tail" defeat switch are "off" and the carrier squelch switching logic is "on". The audio channel is subsequently disabled unless the squelch control logic is overridden by other circuitry.

2.6.2.4 As the input signal level increases (noise decreases), the detector output voltage increases. A detector output voltage above 2.8 volts dc results in enabling of the long "squelch tail" circuit. The long "squelch tail" circuit produces a voltage at U202-12 of 5.5 volts dc; this voltage causes the carrier squelch switching logic circuit to turn "off" and thereby enables the audio channel. Capacitor C236 and resistor R235 provide a rapid-rise, slow-decay time constant to the voltage applied to the carrier squelch switching logic circuit. This permits a weak signal to immediately enable the audio channel, yet delays the audio channel shut-off if the signal is in a "flutter" condition. The voltage necessary to enable the carrier squelch switching logic is approximately 3.8 volts dc.

2.6.2.5 A voltage greater than 5 volts dc at the detector output (rf carrier signal level that produces 20 dB quieting or better with the SQUELCH control set at threshold), turns on the long "squelch tail" defeat switch. This disables the long "squelch tail" circuit and the 150 millisecond delay function. Audio channel disabling now occurs immediately after the rf carrier disappears.

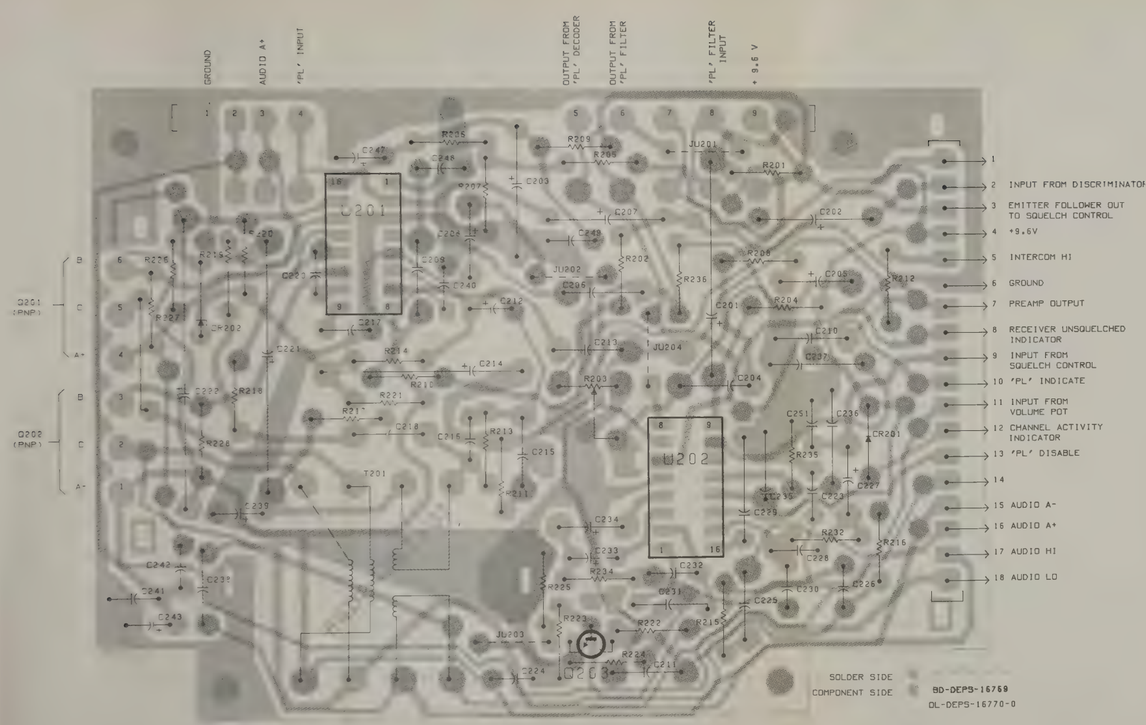
2.6.3 Squelch Output Circuit

The squelch control logic circuit directly controls the shunt switches.

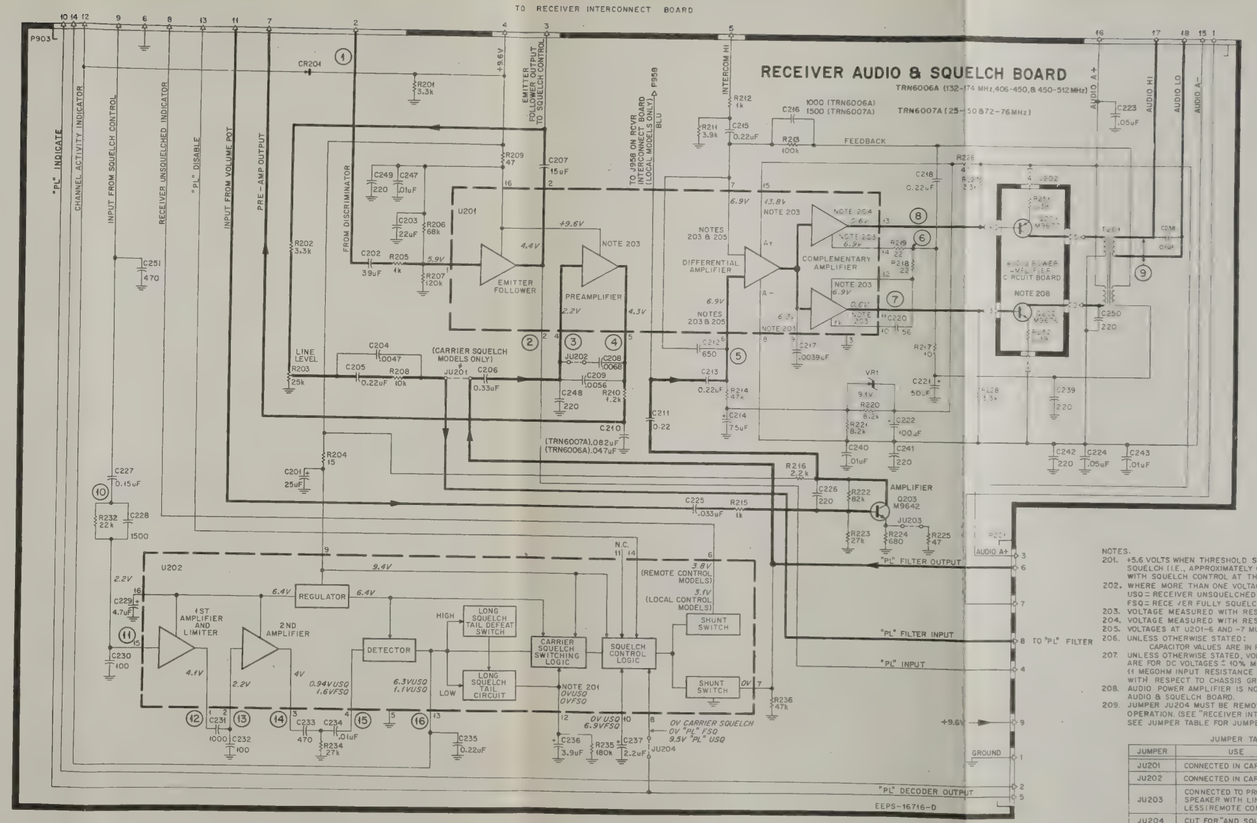
2.6.3.1 The output of the squelch control logic circuit depends upon the output of the preceding carrier squelch switching logic circuit. With the carrier squelch switching logic circuit "off", the squelch control logic circuit will turn off the shunt switches, allowing a message to be heard. If the carrier squelch switching logic is "on", the squelch control logic circuit will turn on the shunt switches, disabling the audio channel, and activating the series switches in the line driver. Capacitor C237, connected to U202-10, slows the turn-off of the shunt switches to "soften" what would otherwise be an annoyingly abrupt turn-on of the audio. This same point (U202-10) supplies a digital output voltage that can be used as an indicator that the receiver is unsquelched (audio channel enabled).

2.6.3.2 Two additional functions that may affect the squelch control logic output are associated with "Private-Line" tone-coded squelch operation. PL disable (U202-14) may be either shorted to ground or open. When an open is present at U202-14 (PL disabled), a received signal with or without a PL tone will be heard from the speaker. When at ground potential (PL enabled), the output of the carrier squelch switching logic circuit is inhibited. When the proper PL tone is received, a positive 9.5 volts dc from the PL decoder board to U202-8 turns off the squelch control logic circuit which turns off the shunt switches and allows a message to be heard. Jumper JU204 is normally in the circuit and is only cut when a field modification is made. The cutting of this jumper and associated modifications on the receiver interconnect board will provide "AND-SQUELCH" operation, changing the PL squelch circuitry from fixed sensitivity operation to variable sensitivity operation. Under this mode of operation, the SQUELCH control will affect the squelch sensitivity.

2.6.3.3 Audio disabling is performed by shunting the audio circuit to ground through a low impedance path and also by the operation of a series switch in the line driver. When the solid state shunt switch is turned "on" (U202-7), signals developed across R236 are shunted to ground. This prevents any signals from being heard at the speaker. Acting in tandem with the first shunt switch, the second shunt switch output is routed to the line driver and enables a set of switches on either of the boards. This breaks the audio path and prevents audio from appearing on the 600-ohm line.



SHOWN FROM SOLDER SIDE



NOTES.
201. +5.6 VOLTS WHEN THRESHOLD SIGNAL JUST OPENS SQUELCH (I.E., APPROXIMATELY 6 dB QUIETING SIGNAL WITH SQUELCH CONTROL AT THRESHOLD).
202. WHERE MORE THAN ONE VOLTAGE READING APPEARS: USQ = RECEIVER UNSQUELCHED
FSQ = RECEIVER FULLY SQUELCHED
203. VOLTAGE MEASURED WITH RESPECT TO A-.
204. VOLTAGE MEASURED WITH RESPECT TO A+.
205. VOLTAGES AT U201-6 AND -7 MUST BE THE SAME VALUE.
206. UNLESS OTHERWISE STATED:
CAPACITOR VALUES ARE IN PICOFARADS.
207. UNLESS OTHERWISE STATED, VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES ± 10% MEASURED WITH AN (1 MEGOHM INPUT RESISTANCE VOLTMETER WITH RESPECT TO CHASSIS GROUND.
208. AUDIO POWER AMPLIFIER IS NOT PART OF AUDIO & SQUELCH BOARD.
209. JUMPER JU204 MUST BE REMOVED FOR "AND SQUELCH" OPERATION. (SEE "RECEIVER INTERCONNECT UNIT" SECTION). SEE JUMPER TABLE FOR JUMPER USE.

JUMPER TABLE

JUMPER	USE
JU201	CONNECTED IN CARRIER SQUELCH STATIONS.
JU202	CONNECTED IN CARRIER SQUELCH STATIONS.
JU203	CONNECTED TO PROVIDE 10 WATTS AUDIO AT SPEAKER WITH LINE LEVELS OF -10 dBM OR LESS (REMOTE CONTROL STATIONS ONLY)
JU204	CUT FOR "AND SQUELCH"

ALL AUDIO CIRCUIT OSCILLOSCOPE WAVEFORMS TAKEN UNDER THE FOLLOWING CONDITIONS

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM
2. HORIZONTAL DEFLECTION = .25 msec/DIV
3. SQUELCH CONTROL FULLY COUNTERCLOCK WISE (OFF). 1000 uV RF SIGNAL INPUT MODULATED WITH 1000 Hz TONE WITH +3.0 kHz DEVIATION.
4. VOLUME CONTROL SET FOR 9.0 V rms AT LOAD
5. OUTPUT TERMINATED IN 8-OHM LOAD
6. R203 SET FOR 175 mV AT PIN 7 WITH +5 kHz DEVIATION (1 kHz TONE)

FPS 8804-O

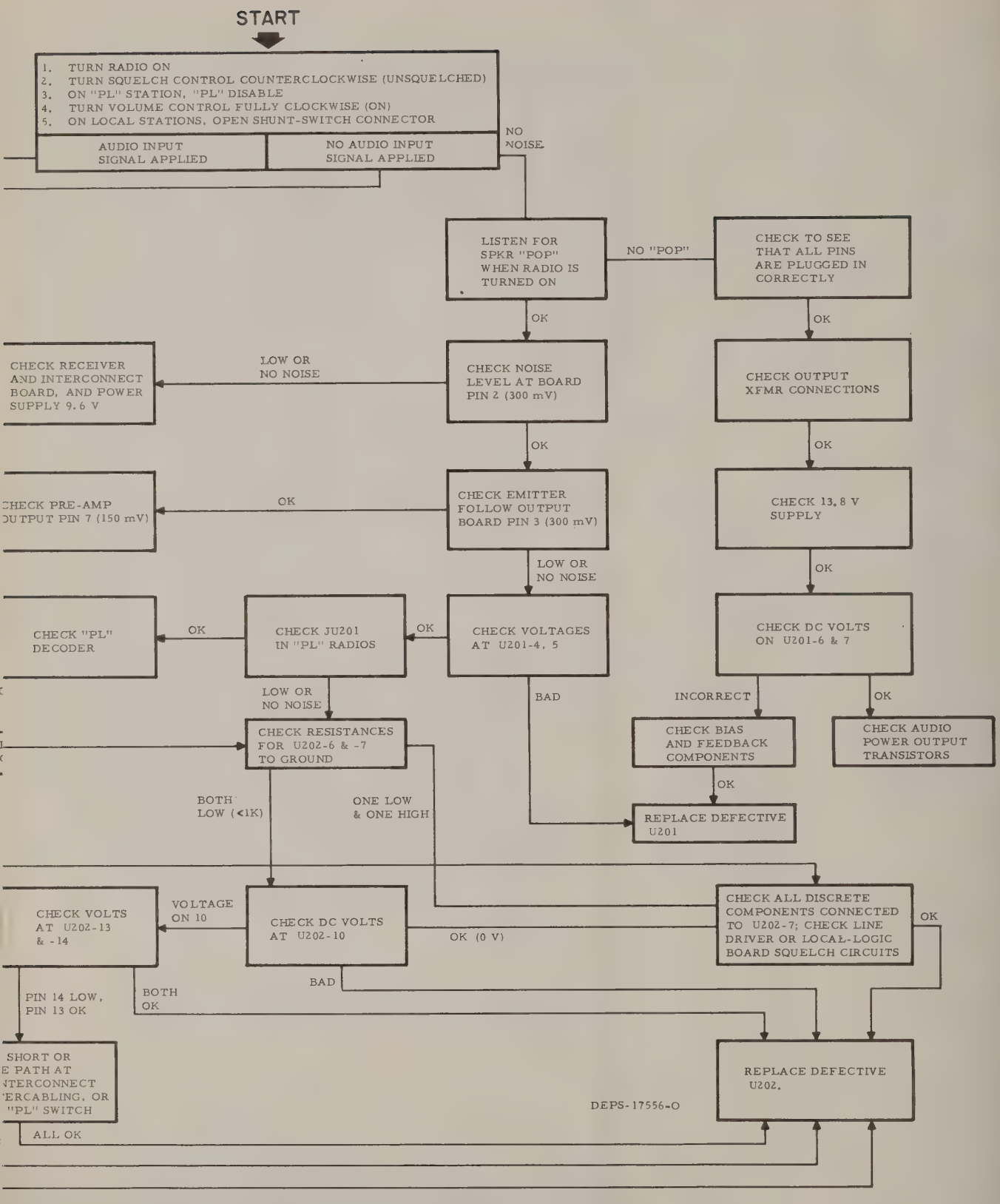
AUDIO CIRCUIT WAVEFORMS

ALL SQUELCH CIRCUIT OSCILLOSCOPE WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY = 0.5 V/DIV.
2. HORIZONTAL DEFLECTION = 2 msec/DIV.
3. SQUELCH CONTROL FULLY CLOCKWISE (ON). NO EXTERNAL SIGNAL APPLIED.
*4. WAVEFORMS (15) AND (16) ARE DC COUPLED WITH ZERO AT BOTTOM. OTHERS AC COUPLED.

EPS 8534-O

SQUELCH CIRCUIT WAVEFORMS

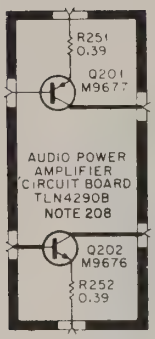

START
1. TURN RADIO ON
2. TURN SQUELCH CONTROL COUNTERCLOCKWISE (UNSQUELCHED)
3. ON "PL" STATION, "PL" DISABLE
4. TURN VOLUME CONTROL FULLY CLOCKWISE (ON)
5. ON LOCAL STATIONS, OPEN SHUNT-SWITCH CONNECTOR
AUDIO INPUT SIGNAL APPLIED
NO AUDIO INPUT SIGNAL APPLIED
NO NOISE
LISTEN FOR SPKR "POP" WHEN RADIO IS TURNED ON
NO "POP"
CHECK TO SEE THAT ALL PINS ARE PLUGGED IN CORRECTLY
OK
OK
CHECK RECEIVER AND INTERCONNECT BOARD, AND POWER SUPPLY 9.6 V
LOW OR NO NOISE
CHECK NOISE LEVEL AT BOARD PIN 2 (300 mV)
CHECK OUTPUT XFMR CONNECTIONS
OK
OK
CHECK PRE-AMP OUTPUT PIN 7 (150 mV)
OK
CHECK EMITTER FOLLOW OUTPUT BOARD PIN 3 (300 mV)
CHECK 13.8 V SUPPLY
LOW OR NO NOISE
OK
CHECK "PL" DECODER
OK
CHECK JU201 IN "PL" RADIOS
OK
CHECK VOLTAGES AT U201-4, 5
CHECK DC VOLTS ON U201-6 & 7
LOW OR NO NOISE
BAD
INCORRECT
OK
CHECK RESISTANCES FOR U202-6 & -7 TO GROUND
CHECK BIAS AND FEEDBACK COMPONENTS
CHECK AUDIO POWER OUTPUT TRANSISTORS
OK
BOTH LOW (<1K)
ONE LOW & ONE HIGH
REPLACE DEFECTIVE U201
CHECK VOLTS AT U202-13 & -14
VOLTAGE ON 10
CHECK DC VOLTS AT U202-10
OK (0 V)
CHECK ALL DISCRETE COMPONENTS CONNECTED TO U202-7; CHECK LINE DRIVER OR LOCAL-LOGIC BOARD SQUELCH CIRCUITS
OK
BAD
PIN 14 LOW, PIN 13 OK
BOTH OK
SHORT OR E PATH AT NTERCONNECT ERCABLING, OR "PL" SWITCH
REPLACE DEFECTIVE U202.
DEPS-17556-O
ALL OK

AUDIO POWER AMPLIFIER

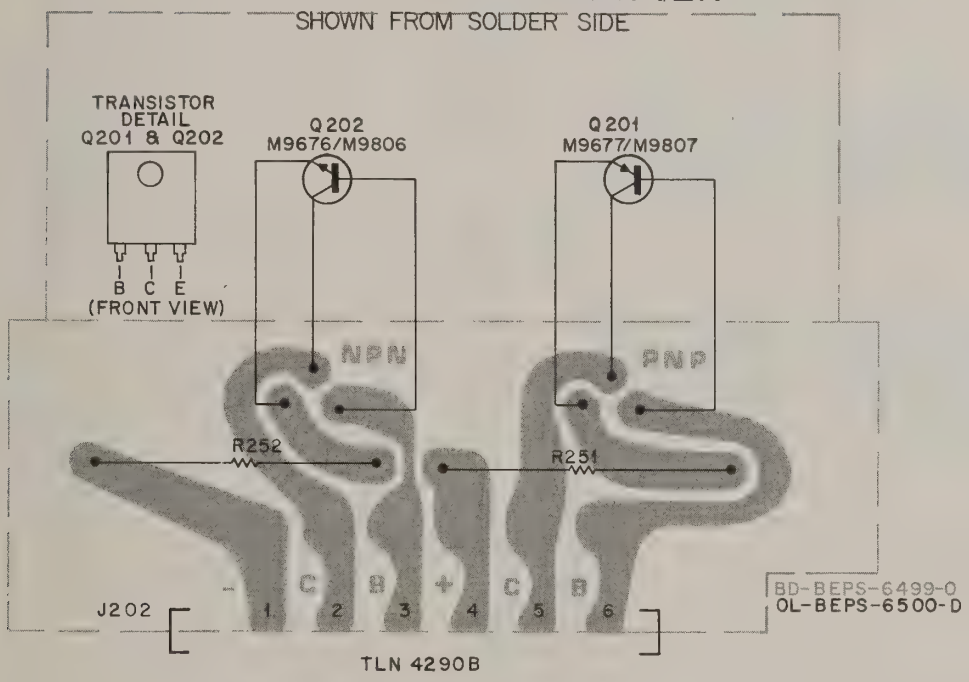
MODEL TLN4290B

FUNCTION --

Provides up to 10 watts audio output.



AUDIO POWER AMPLIFIER



NOTE
208. AUDIO POWER AMPLIFIER IS NOT PART OF AUDIO & SQUELCH BOARD.

PARTS LIST

LEGEND

L = 25-50 & 72-76 MHz
H = 132-174 MHz & 406-512 MHz

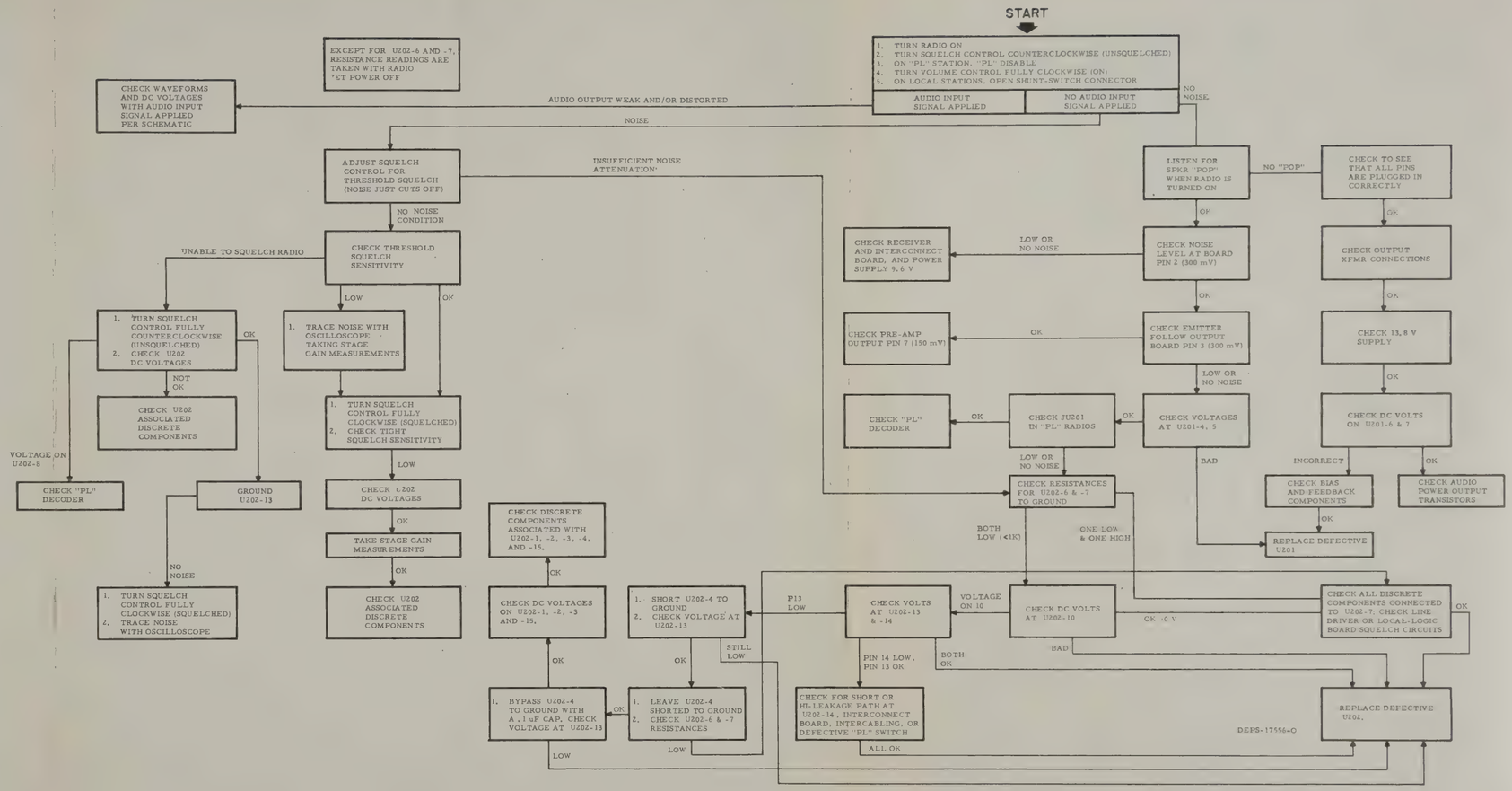
TRN6007A Receiver Audio & Squelch Board
(25-50 & 72-76 MHz)
TRN6006A Receiver Audio & Squelch Board
(132-174 MHz & 406-512 MHz)

PL-3269-B

This parts list covers two models of the Receiver Audio & Squelch Board. Where differences exist a letter suffix L or H is added to the reference symbol to show the applicable unit.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed; uF; ±10%; 100 V; unl. stated
C201	23-83210A01	25 +150-10%; 25 V
C202	23-82783B36	39; 10 V
C203	23-84762H10	22 ±20%; 15 V
C204	8-83813H12	.0047
C205	8-83813H11	0.22; 75 V
C206	8-83813H29	0.33; 50 V
C207	23-82783B24	15; 25 V
C208	8-83813H01	.0068
C209	8-83813H26	.0056 ±5%; 50 V
C210L	8-82905G45	.082; 50 V
C210H	8-82905G03	.047; 50 V
C211	8-83813H11	0.22; 75 V
C212	21-848236	650 pF ±5%; 500 V
C213	8-83813H11	0.22; 75 V
C214	23-84081B03	75 +150-10%; 15 V
C215	8-83813H11	0.22; 75 V
C216L	21-82187B20	1000 pF
C216H	21-82187B31	1500 pF
C217	21-82187B43	.0039; 200 V
C218	8-83813H11	0.22; 75 V
C219		NOT USED
C220	21-83406D46	56 pF ±5%; 500 V; N150
C221	23-84081B01	50 +100-10%; 25 V
C222	23-83210A08	100 +150-10%; 25 V
C223, 224	21-82372C04	.05 +80-20%; 25 V
C225	8-82905G16	.033
C226	21-859942	220 pF ±5%; 500 V
C227	8-83813H07	0.15; 75 V
C228	21-84426B63	1500 pF ±5%
C229	23-84762H07	4.7 ±20%; 10 V
C230	21-84426B06	100 pF ±5%; 500 V
C231	21-84493B05	1000 pF; 200 V; N2200
C232	21-82133G03	100 pF ±5%; 500 V; N750
C233	21-84426B11	470 pF ±5%; 500 V
C234	8-83813H31	.01; 100 V
C235	8-83813H11	0.22; 75 V
C236	23-84762H08	3.9 ±20%; 15 V
C237	23-84762H04	2.2 ±20%; 25 V
C238	21-82372C01	0.1 +80-20%; 25 V
C239	21-83596E10	220 pF ±20%; 500 V
C240	21-832501	.01 +60-40%; 250 V
C241, 242	21-83596E10	220 pF ±20%; 500 V
C243	21-832501	.01 +60-40%; 250 V
C244	21-82133G03	100 pF ±5%; 500 V
C245, 246		NOT USED
C247	21-832501	.01 +60-40%; 250 V
C248 thru 250	21-83596E10	220 pF ±20%; 500 V
C251	21-84426B11	470 pF ±5%; 500 V
		DIODE: (SEE NOTE)
CR201	48-83654H01	silicon
		CONNECTOR, plug:
P201		consists of contact pins mounted on circuit board
		TRANSISTOR: (SEE NOTE)
Q203	48-869642	NPN; type M9642
		RESISTOR, fixed; ±5%; 1/4 W; unl. stated
R201, 202	6-124A61	3.3k
R203	18-83083G24	variable; 25k ±30%
R204	6-124C05	15 ±10%
R205	6-124A49	1k
R206	6-124A93	68k
R207	6-124A99	120k
R208	6-124A73	10k
R209	6-124C17	47 ±10%
R210	6-124A51	1.2k
R211	6-124A63	3.9k
R212	6-124A49	1k
R213	6-124C97	100k ±10%
R214	6-124A89	47k
R215	6-124A49	1k
R216	6-124A57	2.2k
R217	6-124C01	10 ±10%
R218, 219	6-124A09	22
R220, 221	6-124A71	8.2k
R222	6-124A95	82k
R223	6-124A83	27k
R224	6-124A45	680
R225, 226	6-124C17	47 ±10%
R227, 228	6-124A61	3.3k
R229 thru 231		NOT USED
R232	6-124A81	22k
R233		NOT USED
R234	6-124A83	27k
R235	6-124D04	180k ±10%
R236	6-124C89	47k ±10%
		TRANSFORMER, AF:
T201	25-84083B02	pri: split winding; total res 0.5 Ohms max sec: res 0.8 Ohms max feedback: res 2 Ohms max
		INTEGRATED CIRCUIT: (SEE NOTE)
U201	51-84267A08	type SC6708
U202	51-84267A09	type SC6709
		DIODE: (SEE NOTE)
VR1	48-82256C38	Zener; 9.1 V; 400 mW
		NON-REFERENCED ITEMS
	42-84284B01	RETAINER; 4 req'd.
	3-138162	SCREW, tapping: Phillips rd. hd., 4-40 x 3/8"; 4 req'd. (used for mounting Retainers)
	55-84300B01	HANDLE (long)
	55-84300B02	HANDLE (short)
	29-84028H01	TERMINAL, contact; 18 req'd. (long)
	29-84028H02	TERMINAL, contact; 24 req'd. (short)

NOTE: Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

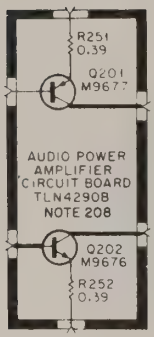

START
1. TURN RADIO ON
2. TURN SQUELCH CONTROL COUNTERCLOCKWISE (UNSQUELCHED)
3. ON "PL" STATION, "PL" DISABLE
4. TURN VOLUME CONTROL FULLY CLOCKWISE (ON)
5. ON LOCAL STATIONS, OPEN SHUNT-SWITCH CONNECTOR
AUDIO INPUT SIGNAL APPLIED
NO AUDIO INPUT SIGNAL APPLIED
NO NOISE
AUDIO OUTPUT WEAK AND/OR DISTORTED
NOISE
EXCEPT FOR U202-6 AND -7, RESISTANCE READINGS ARE TAKEN WITH RADIO "ST POWER OFF
CHECK WAVEFORMS AND DC VOLTAGES WITH AUDIO INPUT SIGNAL APPLIED PER SCHEMATIC
ADJUST SQUELCH CONTROL FOR THRESHOLD SQUELCH (NOISE JUST CUTS OFF)
INSUFFICIENT NOISE ATTENUATION
NO NOISE CONDITION
CHECK THRESHOLD SQUELCH SENSITIVITY
UNABLE TO SQUELCH RADIO
LOW
OK
1. TURN SQUELCH CONTROL FULLY COUNTERCLOCKWISE (UNSQUELCHED)
2. CHECK U202 DC VOLTAGES
OK
NOT OK
CHECK U202 ASSOCIATED DISCRETE COMPONENTS
1. TRACE NOISE WITH OSCILLOSCOPE TAKING STAGE GAIN MEASUREMENTS
1. TURN SQUELCH CONTROL FULLY CLOCKWISE (SQUELCHED)
2. CHECK TIGHT SQUELCH SENSITIVITY
LOW
CHECK U202 DC VOLTAGES
OK
TAKE STAGE GAIN MEASUREMENTS
OK
CHECK U202 ASSOCIATED DISCRETE COMPONENTS
VOLTAGE ON U202-8
CHECK "PL" DECODER
GROUND U202-13
NO NOISE
1. TURN SQUELCH CONTROL FULLY CLOCKWISE (SQUELCHED)
2. TRACE NOISE WITH OSCILLOSCOPE
CHECK DISCRETE COMPONENTS ASSOCIATED WITH U202-1, -2, -3, -4, AND -15.
OK
CHECK DC VOLTAGES ON U202-1, -2, -3 AND -15.
OK
1. BYPASS U202-4 TO GROUND WITH A .1uF CAP, CHECK VOLTAGE AT U202-13
OK
LOW
1. SHORT U202-4 TO GROUND
2. CHECK VOLTAGE AT U202-13
OK
STILL LOW
1. LEAVE U202-4 SHORTED TO GROUND
2. CHECK U202-6 & -7 RESISTANCES
LOW
P13 LOW
CHECK VOLTS AT U202-13 & -14
VOLTAGE ON 10
PIN 14 LOW, PIN 13 OK
CHECK FOR SHORT OR HI-LEAKAGE PATH AT U202-14, INTERCONNECT BOARD, INTERCABLING, OR DEFECTIVE "PL" SWITCH
ALL OK
CHECK DC VOLTS AT U202-10
OK TO V
BOTH OK
BAD
CHECK ALL DISCRETE COMPONENTS CONNECTED TO U202-7; CHECK LINE DRIVER OR LOCAL LOGIC BOARD SQUELCH CIRCUITS
OK
REPLACE DEFECTIVE U202.
DEPS-17556-O
LISTEN FOR SPKR "POP" WHEN RADIO IS TURNED ON
NO "POP"
OK
CHECK TO SEE THAT ALL PINS ARE PLUGGED IN CORRECTLY
OK
CHECK NOISE LEVEL AT BOARD PIN 2 (300 mV)
LOW OR NO NOISE
CHECK RECEIVER AND INTERCONNECT BOARD, AND POWER SUPPLY 9.6 V
OK
CHECK OUTPUT XFMR CONNECTIONS
OK
CHECK EMITTER FOLLOW OUTPUT BOARD PIN 3 (300 mV)
OK
CHECK PRE-AMP OUTPUT PIN 7 (150 mV)
OK
CHECK 13.8 V SUPPLY
OK
LOW OR NO NOISE
CHECK VOLTAGES AT U201-4, 5
OK
CHECK JU201 IN "PL" RADIOS
OK
CHECK "PL" DECODER
OK
CHECK DC VOLTS ON U201-6 & 7
BAD
LOW OR NO NOISE
CHECK RESISTANCES FOR U202-6 & -7 TO GROUND
INCORRECT
OK
CHECK BIAS AND FEEDBACK COMPONENTS
CHECK AUDIO POWER OUTPUT TRANSISTORS
OK
REPLACE DEFECTIVE U201
BOTH LOW (<1K)
ONE LOW & ONE HIGH

AUDIO POWER AMPLIFIER

MODEL TLN4290B

FUNCTION --

Provides up to 10 watts audio output.



AUDIO POWER AMPLIFIER

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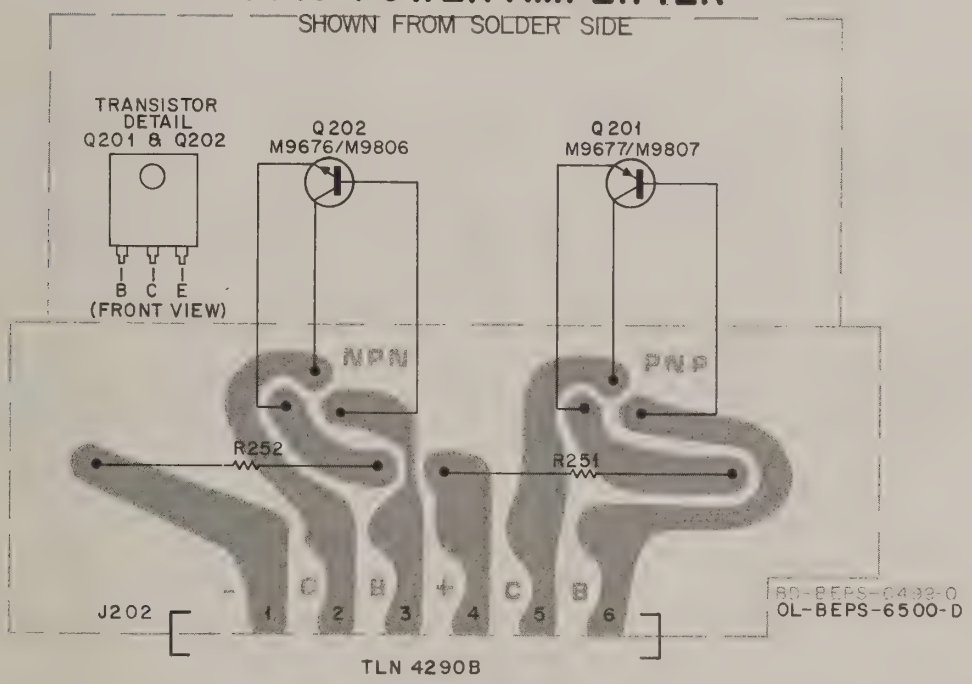
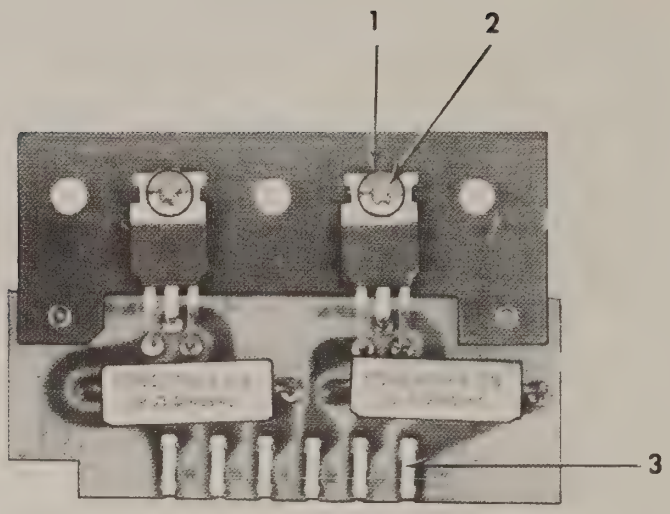


NOTE

208. AUDIO POWER AMPLIFIER IS NOT PART OF AUDIO & SQUELCH BOARD.



AEPS-6502-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST
AUDIO POWER AMPLIFIER

TLN4290B Audio Power Amplifier PL-1062-E

CODE NO.	MOTOROLA PART NO.	DESCRIPTION
1	4B84180C01	WASHER, shoulder
2	3S129841	SCREW, machine: No. 4-40 x 1/4"; incl. lockwasher
3	9B83011H01	PIN, female

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

AUDIO PA

TLN4290B Audio Power Amplifier PL-1061-C

J202		CONNECTOR, receptacle: c/o; 9B83011H01 PIN, female; 6 req'd
		TRANSISTOR: (SEE NOTE)
Q201	48R869807 or48R869677	PNP; type M9807 PNP; type M9677
Q202	48R869806 or48R869676	NPN; type M9806 NPN type M9676
		RESISTOR, fixed: ±10%; 3 W:
R251	17D82177B49	0.39
R252	17D82177B49	0.39

TECHNICA NE "PRIVATE-LINE" DECODER

MODEL TRN6002A

FREQUENCY DETERMINING DEVICE
"PL" TONE FREQUENCY
TONE ACCURACY
TONE BANDWIDTH
TONE SENSITIVITY
OUTPUT
POWER REQUIREMENT

FUNCTION --

Unsquelches receiver upon receipt of proper "Private-Line" tone.

1. DESCRIPTION

This decoder provides a dc output volta to unsquelch the receiver's audio section on when the proper PL tone is received. The coder will respond only to a specific, contin uous low-frequency tone from a transmitter the same "Private-Line" network.

2. FUNCTIONAL OPERATION

2.1 GENERAL

2.1.1 "PL" Tone Present

2.1.1.1 The PL filter passes low frequency PL tones and attenuates signals abo 300 Hz. The noise switch shorts out high f quency noise signals. The tone from the P filter is limited to a fixed level by the ampl clipper and then applied to the "Vibrasponde resonant reed which vibrates when the tone same frequency as the reed's resonant freq When the reed is vibrating, the tone is appl a detector which develops a dc output which vates the output switch. When the output sw is activated, 9.5 volts is present at its outp enable the audio circuits. The output also a vates the noise switch.

2.1.1.2 A separate high pass audio filt located on the PL decoder boa which allows voice signals above 300 Hz to but blocks PL tones. This filter is connect series with the audio signal path to prevent PL tone from being heard in the speaker.

2.1.2 "PL" Tone Absent

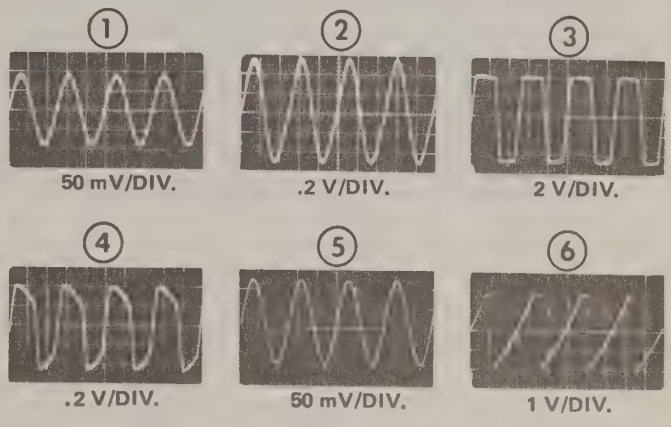
When no PL tone is present, the output switch is off. The output voltage is at this time which inhibits the squelch circu prevent an audio output to the speaker. Th switch is off at this time which allows high quency noise to bypass the PL filter. The of high frequency noise desensitizes the am fiers and acts as an "anti-falsing" feature t vent a random low-frequency noise signal f activating the resonant reed.

2.2 DECODER INPUT CIRCUITS

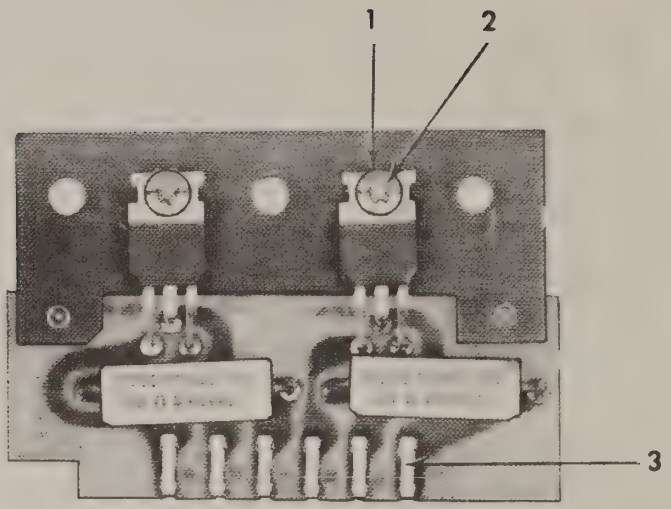
2.2.1 The receiver discriminator outpu nal consists of noise only when n carrier signal is being received. With a ca signal input to the receiver, the noise is re and voice audio or voice audio and PL tone

2.2.2 These input signals are routed th the low pass filter and noise gate A receiver input signal that is modulated ±0 with PL tone produces a nominal 60 millivo signal at the input to the decoder. The low filter consisting of L801, C802, C803 and C attenuates sharply all signals above 300 Hz voice and noise signals above 300 Hz are bl

"PL" DECODER WAVEFORMS



EPS-6182-B



AEPS-6502-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST
AUDIO POWER AMPLIFIER

TLN4290B Audio Power Amplifier PL-1062-E

CODE NO.	MOTOROLA PART NO.	DESCRIPTION
1	4B84180C01	WASHER, shoulder
2	3S129841	SCREW, machine: No. 4-40 x 1/4"; incl. lockwasher
3	9B83011H01	PIN, female

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

AUDIO PA

TLN4290B Audio Power Amplifier PL-1061-C

J202		CONNECTOR, receptacle: c/o; 9B83011H01 PIN, female; 6 req'd
		TRANSISTOR: (SEE NOTE)
Q201	48R869807	PNP; type M9807
	or48R869677	PNP; type M9677
Q202	48R869806	NPN; type M9806
	or48R869676	NPN type M9676
		RESISTOR, fixed: ±10%; 3 W:
R251	17D82177B49	0.39
R252	17D82177B49	0.39

TONE "PRIVATE-LINE" DECODER

MODEL TRN6002A

FUNCTION --

Unsquelches receiver upon receipt of proper "Private-Line" tone.

TECHNICAL CHARACTERISTICS

FREQUENCY DETERMINING DEVICE	"Vibrasponder" resonant reed
"PL" TONE FREQUENCY	Selected from 67-210 Hz range
TONE ACCURACY	±0.15%
TONE BANDWIDTH	Approximately 1 Hz
TONE SENSITIVITY	0.25 volt ac rms reed drive
OUTPUT	9.5 volts dc switched
POWER REQUIREMENT	9.6 volts dc @15 milliamperes

1. DESCRIPTION

This decoder provides a dc output voltage to unsquelch the receiver's audio section only when the proper PL tone is received. The decoder will respond only to a specific, continuous low-frequency tone from a transmitter in the same "Private-Line" network.

2. FUNCTIONAL OPERATION

2.1 GENERAL

2.1.1 "PL" Tone Present

2.1.1.1 The PL filter passes low frequency PL tones and attenuates signals above 300 Hz. The noise switch shorts out high frequency noise signals. The tone from the PL filter is limited to a fixed level by the amplifier/clipper and then applied to the "Vibrasponder" resonant reed which vibrates when the tone is the same frequency as the reed's resonant frequency. When the reed is vibrating, the tone is applied to a detector which develops a dc output which activates the output switch. When the output switch is activated, 9.5 volts is present at its output to enable the audio circuits. The output also activates the noise switch.

2.1.1.2 A separate high pass audio filter is located on the PL decoder board which allows voice signals above 300 Hz to pass but blocks PL tones. This filter is connected in series with the audio signal path to prevent the PL tone from being heard in the speaker.

2.1.2 "PL" Tone Absent

When no PL tone is present, the output switch is off. The output voltage is 0 volts at this time which inhibits the squelch circuit to prevent an audio output to the speaker. The noise switch is off at this time which allows high frequency noise to bypass the PL filter. The presence of high frequency noise desensitizes the amplifiers and acts as an "anti-falsing" feature to prevent a random low-frequency noise signal from activating the resonant reed.

2.2 DECODER INPUT CIRCUITS

2.2.1 The receiver discriminator output signal consists of noise only when no carrier signal is being received. With a carrier signal input to the receiver, the noise is reduced and voice audio or voice audio and PL tone added.

2.2.2 These input signals are routed through the low pass filter and noise gate circuit. A receiver input signal that is modulated ±0.05 kHz with PL tone produces a nominal 60 millivolts rms signal at the input to the decoder. The low pass filter consisting of L801, C802, C803 and C805 attenuates sharply all signals above 300 Hz. Thus, voice and noise signals above 300 Hz are blocked, but PL tones are passed. High pass filter C801, R803, and C807 presents a parallel path for high frequency noise whenever the decoder is not activated. This condition is desirable so that low frequency noise (only) will not falsely activate the decoder. When the proper tone has been received and the decoder is activated, noise switch Q807 acts as a short and grounds all high frequency signals before they reach amplifier Q801.

2.3 INPUT AMPLIFIER CIRCUITS

Amplifier Q801 amplifies noise and PL tone signals which are coupled to amplifier/clipper Q802. Diode CR801 and the base emitter junction of Q802 limit both the positive and negative swing of the signal to a maximum amplitude. The amplified output of Q802 provides a constant amount of drive even though the amount of PL tone deviation from various transmitters is not constant. It also limits the noise signals to prevent oversensitivity to noise signals which could falsely operate the "Vibrasponder" resonant reed. "Vibrasponder" driver Q803 operates as an emitter follower to provide current drive to the low impedance "Vibrasponder" resonant reed.

2.4 "VIBRASPONDER" RESONANT REED

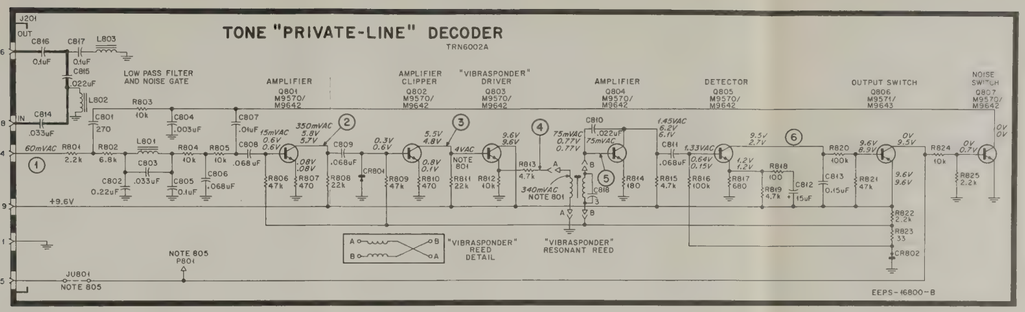
At resonance, the reed acts as a high Q transformer coupling energy from the primary to the secondary winding. At all other frequencies, the reed will not vibrate and no energy is coupled to the secondary winding.

2.5 OUTPUT CIRCUIT

When the proper PL tone is applied to the reed, it develops a sinusoidal wave output at its resonant frequency. This sinusoidal wave is amplified by Q804. Negative feedback through C810 maintains the sinusoidal waveform. The amplified signal is coupled to detector Q805 which converts the signal to a dc potential. Q805 is cut off with its collector voltage of 9.6 volts until the tone is applied. With tone applied, the positive most portion of the sinusoidal wave is clamped at approximately .6 volt. The positive swing of each cycle causes momentary conduction of Q805 and the collector voltage drops to near zero volts. C813 charges during the conduction period and discharges through R820 and R821 to develop a filtered dc potential which forward biases output switch Q806. With Q806 activated, 9.6 volts is gated to the output which unsquelches the receiver. Noise switch Q807 is also activated which places a short across the noise gate as explained in paragraph (b).

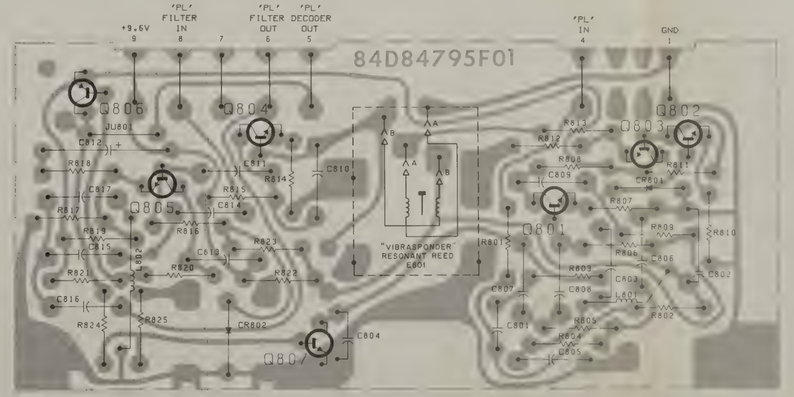
2.6 AUDIO FILTER

Audio and PL tone from the VOLUME control are routed through an audio filter consisting of C814-C817 and L802 and L803. The filter is electrically separate from the decoder but physically mounted on the same board. This filter is high-pass type which blocks the PL tone and passes the audio to the audio & squelch board.



NOTES:

801. DUE TO SQUARE WAVE CHARACTERISTIC SOME METERS RESPOND DIFFERENTLY. VOLTAGE SHOULD BE MEASURED WITH AN OSCILLOSCOPE.
802. AC VOLTAGE READINGS ARE RMS VALUES WITH 60 MILLIVOLTS "PL" TONE INPUT. USE HIGH IMPEDANCE (10 MEGOHM) AC VOLTMETER. MEASUREMENT MADE WITH RESPECT TO CHASSIS GROUND.
803. DC VOLTAGE READINGS TAKEN WITH HIGH IMPEDANCE (1M MEGOHM) DC VOLTMETER. TOP VALUE IS MEASURED WITHOUT "PL" TONE. BOTTOM VALUE IS MEASURED WITH 60 MILLIVOLTS "PL" TONE INPUT. MEASUREMENT MADE WITH RESPECT TO CHASSIS GROUND.
804. UNLESS OTHERWISE STATED: RESISTOR VALUES ARE IN OHMS; CAPACITOR VALUES ARE IN PICOFARADS.
805. JUMPER J0801 AND P801 ARE INCORPORATED IN MODEL TRN6002A ONLY. J0801 IS REMOVED AND P801 IS USED ONLY FOR CERTAIN OPTIONAL EQUIPMENT.



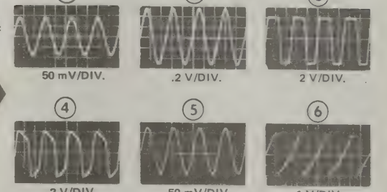
SHOWN FROM SOLDER SIDE

DD CEPS-16801-A
DL-CEPS-16802-8

WAVEFORMS MEASURED UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
2. HORIZONTAL DEFLECTION = 5 msec/DIV.
3. WITH RECEIVER OPERATING PROPERLY:
   - A. INJECT 1000 uV RF CARRIER AT ANTENNA CONNECTOR.
   - B. MODULATE CARRIER WITH "PL" TONE. ADJUST MODULATION FOR WAVEFORM ① : I.E. 60 mV rms (170 mV P-P) AT J201-2.
4. RECEIVER NOT USED:
   - A. INJECT "PL" TONE AT J201-2.
   - B. ADJUST TONE LEVEL FOR WAVEFORM ① .
5. OSCILLOSCOPE VERTICAL INPUT – AC.
6. OSCILLOSCOPE SYNC -- INTERNAL.
7. MEASUREMENTS MADE WITH RESPECT TO CHASSIS GROUND.

"PL" DECODER WAVEFORMS



EPS-6182-8

MAINTAINANCE

a. Recommended Test Equipment

(1) Motorola S1318A Series RF Signal Generator. This solid-state unit provides receiver rf carrier signals.

(2) Motorola SLN6221A "PL" Tone Generator and "Vibrasender" resonant reed on the same frequency as the "Vibrasponder" resonant reed of the decoder. An audio signal generator may be used if it is accurately set to the decoder frequency. However, to obtain the accuracy necessary, the frequency should be adjusted while the signal is measured on a frequency counter.

(3) Motorola Solid-State Oscilloscope for tone signal measurement. Some measurements may be taken with a high impedance ac voltmeter.

(4) Motorola Solid-State DC Multimeter for dc voltage measurements.

b. Performance Tests

A 0.25 microvolt rf carrier signal modulated ±0.5 kHz with PL tone should unsquelch the receiver. This can be checked as follows:

(1) Connect the rf signal generator to the receiver rf input receptacle. Set the signal generator to the receiver carrier frequency, then set the output to minimum.

(2) Modulate the signal generator output ±0.5 kHz with a PL tone of the frequency stamped on the "Vibrasponder" resonant reed. The tone can be generated with a Motorola SLN6221A "PL" Tone Generator and a "Vibrasponder" resonant reed. The "Vibrasender" reed from the PL encoder may be used if it is the proper frequency.

(3) Also modulate the signal generator with an audio tone in the 300 to 3000 Hz range at ±3.3 kHz.

(4) Increase the output of the signal generator until the receiver unsquelches and the audio tone is heard on the speaker. No more than 0.25 microvolt should be required to unsquelch the receiver.

c. Troubleshooting

If the PL decoder does not operate, or operates improperly, the following hints may be helpful in locating the malfunction.

(1) Testing the "Vibrasponder" Resonant Reed

One of the first tests should be a check of the "Vibrasponder" resonant reed. Inject a 340 millivolt rms PL tone of the proper frequency directly to the primary of the reed. Use an oscilloscope or ac voltmeter to check the output across the secondary of the reed. Approximately 75 millivolts rms should be measured. If the reed is good, continue with other decoder tests.

(2) Decoder Testing

To test the decoder, inject a 1000 microvolt carrier signal into the receiver. Adjust PL modulation for 60 millivolts rms tone signal at the input to the decoder (test point (1) on the schematic diagram and circuit board detail). If the PL tone is injected directly into the decoder for testing, an rf carrier signal should be injected into the receiver to quiet the receiver noise. Otherwise, noise and PL tone will both be present and will produce erroneous readings.

With 60 millivolts PL tone input, measure signal and dc voltages at various points in the decoder to isolate the trouble. Typical values for a normally operating decoder are given on the schematic diagram. Some waveforms are not sinusoidal and should be measured with an oscilloscope. Most ac voltmeters are calibrated to read accurately only for sinusoidal signals.

If under normal operating conditions, the PL tones are heard with the speaker audio, the high pass filter on the decoder board should be checked.

NOTE

The "PL" decoder can be removed from its normal position in the receiver chassis and plugged on the front or circuitry side of the audio board. Parallel-connected pins have been provided for ease of servicing. Remove the audio board shield for access to these pins.

"DIGITAL PRIVATE-LINE" DECODER

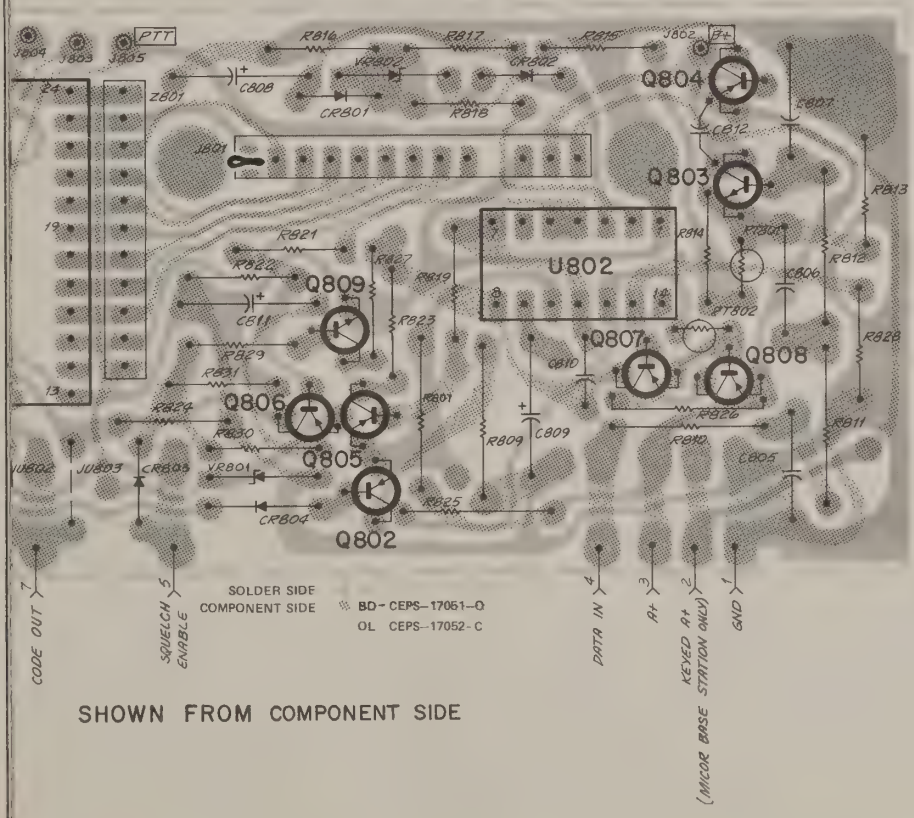
MODEL TLN5729A

FUNCTION

1. Decodes A 23-bit binary code word to unsquelch the receiver.
2. In radios with simplex "Digital Private-Line" operation, generates a 23-bit binary code word when the transmitter is keyed.

TECHNICAL CHARACTERISTICS

CODE DETERMINING DEVICE	TRN6005A CODE PLUG
CODE FORMAT	23-BIT WORD
CODE FREQUENCY SPECTRUM	11-67 Hz
OUTPUT	SWITCHED 5.3 V DC



SHOWN FROM COMPONENT SIDE

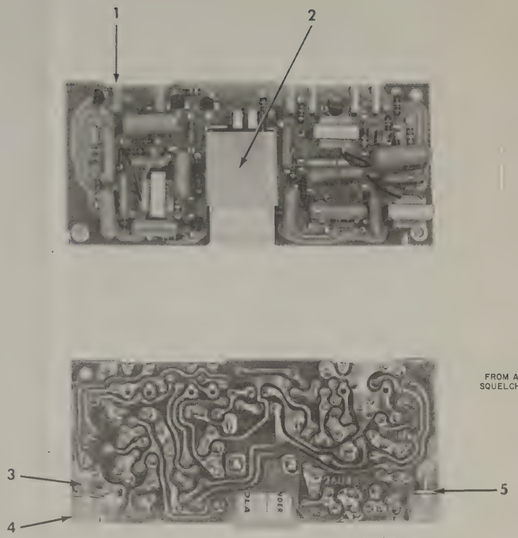
ELECTRICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TRN6002A Tone "Private-Line" Decoder PL-3259-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; 50 V; unless otherwise stated
C801	21-82187B38	270 pF
C802	8-82905G32	0.22
C803	8-82905G08	.033; 100 V
C804	21-82187B26	.003; 100 V
C805	8-83813H06	0.1; 100 V
C806	8-82905G04	.068; 100 V
C807	8-82905G01	.01
C808, 809	8-82905G04	.068; 100 V
C810	8-82905G02	.022
C811	8-82905G04	.068; 100 V
C812	23-83214C02	15 ±20%; 25 V
C813	8-82905G31	0.15
C814	8-83293B10	.033; ±5%
C815	8-83813H16	.022 ±5%
C816	8-82905G30	0.1
C817	8-82095G14	0.1 ±5%; 200 V
C818	21-83406D51	3 pF ±0.25 pF; 500 V
		DIODE: (SEE NOTE I)
CR801, 802	48-83654H01	silicon
		"VIBRASPONDER" RESONANT REED: (SEE NOTE II)
E801	TLN8381A	plug-in unit
		COIL, RF: choke
L801, 802, 803	24-84003A01	6 H
		TRANSISTOR: (SEE NOTE I)
Q801 thru 805	48-869642 or 48-869570	NPN; M9642 NPN; M9570
Q806	48-869643 or 48-869571	PNP; M9643 PNP; M9571
Q807	48-869642 or 48-869570	NPN; M9642 NPN; M9570
		RESISTOR, fixed: ±5%; 1/4 W; unless otherwise stated
R801	6-124C57	2.2k ±10%
R802	6-124C69	6.8k ±10%
R803, 804, 805	6-124C73	10k ±10%
R806	6-124A89	47k
R807	6-124A41	470
R808	6-124A81	22k
R809	6-124A89	47k
R810	6-124A41	470
R811	6-124A81	22k
R812	6-124C73	10k ±10%
R813	6-124A65	4.7k
R814	6-124A31	180
R815	6-124A65	4.7k
R816	6-124A97	100k
R817	6-124A45	680
R818	6-124C25	100 ±10%
R819	6-124A65	4.7k
R820	6-124A97	100k
R821	6-124A89	47k
R822	6-124A57	2.2k
R823	6-124A13	33
R824	6-124C73	10k ±10%
R825	6-124C57	2.2k ±10%



AEPS-6105-O

MECHANICAL PARTS LIST

TRN6002A Tone "Private-Line" Decoder PL-3261-A

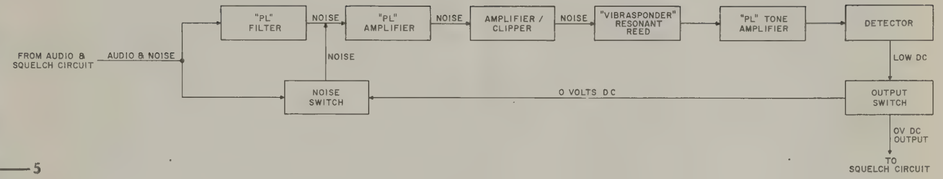
ITEM	MOTOROLA PART NO.	DESCRIPTION
1	9-83011H01	TERMINAL, pin: female; 6 req'd.
2	42-84116B01	SOCKET & CLAMP ASSY
3	3-136905	SCREW, lock: No. 4 x 5/16"; 2 req'd.
4	42-84284B01	RETAINER, Nylon: 2 req'd.
5	7-84223B01	BRACKET, retainer

NOTES:

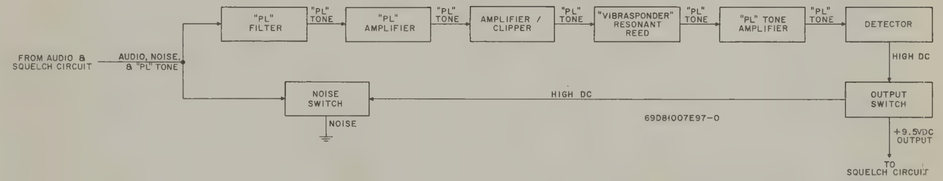
I. For optimum performance, replacement diodes and transistors must be ordered by Motorola part number.

II. The "Vibrasponder" Resonant Reed (Model TLN8381A) is not part of the decoder board. When ordering the complete board, the reed must be ordered separately.

"PL" TONE ABSENT



"PL" TONE PRESENT



MAINTAINANCE

a. Recommended Test Equipment

(1) Motorola S1318A Series RF Signal Generator. This solid-state unit provides receiver rf carrier signals.

(2) Motorola SLN6221A "PL" Tone Generator and "Vibrasender" resonant reed on the same frequency as the "Vibrasponder" resonant reed of the decoder. An audio signal generator may be used if it is accurately set to the decoder frequency. However, to obtain the accuracy necessary, the frequency should be adjusted while the signal is measured on a frequency counter.

(3) Motorola Solid-State Oscilloscope for tone signal measurement. Some measurements may be taken with a high impedance ac voltmeter.

(4) Motorola Solid-State DC Multimeter for dc voltage measurements.

b. Performance Tests

A 0.25 microvolt rf carrier signal modulated ±0.5 kHz with PL tone should unsquelch the receiver. This can be checked as follows:

(1) Connect the rf signal generator to the receiver rf input receptacle. Set the signal generator to the receiver carrier frequency, then set the output to minimum.

(2) Modulate the signal generator output ±0.5 kHz with a PL tone of the frequency stamped on the "Vibrasponder" resonant reed. The tone can be generated with a Motorola SLN6221A "PL" Tone Generator and a "Vibrasponder" resonant reed. The "Vibrasender" reed from the PL encoder may be used if it is the proper frequency.

(3) Also modulate the signal generator with an audio tone in the 300 to 3000 Hz range at ±3.3 kHz.

(4) Increase the output of the signal generator until the receiver unsquelches and the audio tone is heard on the speaker. No more than 0.25 microvolt should be required to unsquelch the receiver.

c. Troubleshooting

If the PL decoder does not operate, or operates improperly, the following hints may be helpful in locating the malfunction.

(1) Testing the "Vibrasponder" Resonant Reed

One of the first tests should be a check of the "Vibrasponder" resonant reed. Inject a 340 millivolt rms PL tone of the proper frequency directly to the primary of the reed. Use an oscilloscope or ac voltmeter to check the output across the secondary of the reed. Approximately 75 millivolts rms should be measured. If the reed is good, continue with other decoder tests.

(2) Decoder Testing

To test the decoder, inject a 1000 microvolt carrier signal into the receiver. Adjust PL modulation for 60 millivolts rms tone signal at the input to the decoder (test point (1) on the schematic diagram and circuit board detail). If the PL tone is injected directly into the decoder for testing, an rf carrier signal should be injected into the receiver to quiet the receiver noise. Otherwise, noise and PL tone will both be present and will produce erroneous readings.

With 60 millivolts PL tone input, measure signal and dc voltages at various points in the decoder to isolate the trouble. Typical values for a normally operating decoder are given on the schematic diagram. Some waveforms are not sinusoidal and should be measured with an oscilloscope. Most ac voltmeters are calibrated to read accurately only for sinusoidal signals.

If under normal operating conditions, the PL tones are heard with the speaker audio, the high pass filter on the decoder board should be checked.

NOTE

The "PL" decoder can be removed from its normal position in the receiver chassis and plugged on the front or circuitry side of the audio board. Parallel-connected pins have been provided for ease of servicing. Remove the audio board shield for access to these pins.

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION

PARTS LIST

TRN6005A Decoder Circuit Board

	21-84216A22	200 V
	21-84242B80	1,000 V
	21-84284B80	1.0 μF±20%, 35 V
	8-84280B24	.023 μF±5%, 50 V
	8-84381H23	.068 μF±5%, 50 V
	8-84381H19	.0039 μF±5%, 50 V
	23-84742H03	10 μF±10%, 20 V
		0.68 μF±5%, 35 V
		1000 pF ±10%, 100 V
R801, 802	48-84616A01	DIODE: (SEE NOTE) hot carrier
R803	48-84634H01	silicon
CR804	48-82139C01	germanium
Q801	48-84896A53	TRANSISTOR: (SEE NOTE) field-effect; type M9653
Q802	48-84896A48	type M7649
Q803, 809, 810	48-84896A42	type M9642
Q804, 805, 806, 807	48-84896A43	PNP: type M9643
Q808	48-84896A41	PNP: type M9841
R801, 802, 803		RESISTOR, fixed: ±10%; 1/4 W; unless otherwise stated
R802, 804		470
R805		1 K
R806		180K
R807		100, 1/2 W
R808		180
R809		56.2 K ±1%
	6-84284A48	-
	6-84284A44	-
	6-84284C43	-
	6-84284C75	-
	6-84284C35	-
	6-84284C51	-
	6-84284A59	-
	6-84284A57	-
	6-83755C67	-
	6-84621C39	-
	6-84284C83	-
	6-84284B10	-
RT801	6-84684A41	THERMISTOR: 100 ohm @ 25°C
RT802	6-84684B01	10k ohms @ 25°C
	51-84267A42	INTEGRAT D CIRCUIT: (SEE NOTE) MC1582
	51-84420A55	M2055
VR801	48-84894C07	VOLTAGE REGULATOR: Zener type: 6.2 V
	48-84284C03	Zener type: 4.70 V
	48-82003C01	CRYSTAL: resonator: 50.00000 KC
	1-80772B36 or 51-82142B02	RESISTOR NETWORK: pull-up, 10-pin

NOTE: For optimum performance, diodes, transistors and integrated circuits must be ordered by Motorola part numbers.

NOTES:
1. UNLESS OTHERWISE INDICATED: RESISTOR VALUES ARE IN OHMS CAPACITOR VALUES ARE IN MICROFARADS.
2. JUMPER APPLICATIONS

JUMPER	"MICOR" MOBILE	"MICOR" BASE (MTR)	"MICOR" BASE STATION
J1801	OUT	IN	OUT
J1802	IN	IN	IN
J1803	OUT	OUT	OUT

KEYED A = (1) APPLIED TO PIN 2 IN "MICOR" BASE STATION APPLICATIONS AND VIA T CODE ENABLE IS APPLIED TO J805 IN "MICOR" MOBILE APPLICATIONS.
4. B+ IN MOBILE APPLICATION & 4+ IN BASE STATION.
5. AUDIO SAMPLING MUST BE TAKEN WITH AN ON CHANNEL RF INPUT SIGNAL OF 1000 μV, MODULATED WITH 1000 Hz TONE AT 25 kHz DEVIATION AND A "DIGITAL PRIVATE-LINE" SIGNAL AT 1.0 kHz DEVIATION.
6. LOGIC "0" = +0.9 V
   LOGIC "1" = 5 V
7. U801 IS A CMOS DEVICE. OBSERVE CMOS HANDLING PRECAUTIONS.
8. WHEN THE TLN5729A "DIGITAL PRIVATE-LINE" DECODER IS USED WITH THE TRN6644A TRN6645A OR TLN4900 AUDIO AND SQUELCH BOARD IN "MICOR" MOBILE APPLICATIONS REFER TO DETAIL B FOR INTERCONNECTION INFORMATION.

OCTAL (BASE 8) / BINARY (BASE 2) / CODE NUMBER EXAMPLE FOR CODE 423

OCTAL	BINARY
0	000
1	001
2	010
3	011
4	100
5	101
6	110
7	111

LSB 3 2 4 MSB
1 1 0 0 1 0 0 0 1
23 22 21 20 19 18 17 16 15
C B A
LSD MSD

U801 PIN NO

TRN6005A CODE PLUG
DETAIL A

TECHNICIANS WHO HAVE NOT PREVIOUSLY SERVICED "DIGITAL PRIVATE - LINE" CIRCUITS ARE INVITED TO ORDER MOTOROLA BOOKLET 68P81106E83 (ENTITLED "DIGITAL PRIVATE - LINE" BINARY - CODED SQUELCH, WHICH COVERS THE FUNDAMENTALS OF SYSTEM OPERATION, CIRCUIT OPERATION AND SERVICING TECHNIQUES. AT THE TIME OF THIS ORDER BLANK AT THE FRONT OF THIS MANUAL TO ORDER YOUR FREE COPY.

CODE PLUG DETERMINES CODE WORD THAT IS GENERATED OR RECEIVED

TRN6005A CODE PLUG OR TLN5730A 2 CODE ADAPTER BOARD (SEE DETAIL A)

U801 CONTINUOUSLY GENERATES 23 BIT CODE WORD AT CODE OUTPUT. U801-5, DURING TRANSMIT, PROVIDES HIGH LEVEL AUDIO ENABLE AT U801-7 OUTPUT. AFTER INCOMING BINARY CODE IS DECODED, GENERATES 134 Hz SYMMETRICAL SQUARE WAVES (TURN OFF CODE) AT CODE OUTPUT U801-6 IN QUIESCENT STATE

U801 CODE GENERATOR / DECODER (NOTE ⊕ & ⊖)

U801 1Y WAVEFORM

U801 5 WAVEFORM

U801 7 WAVEFORM

U801 6 WAVEFORM

CODE OUT WAVEFORM

QUIESCENT STATE OUTPUT U801-3 HIGH / LOW

BUFFER

U801 DETERMINES CLOCK FREQUENCY FOR U801 APPLIED IN FEEDBACK PATH FROM U801 4 TO U801-3

U801 AND R804 HOLD PIN 3 HIGH FOR APPROXIMATELY 500 MILLISECONDS AFTER POWER IS APPLIED

BASE STATIONS: SHORT U801 9 TO GROUND AND KEY TRANSMITTER TO GENERATE CONTINUOUS TURN OFF CODE. SEE ALSO ACTIVE FILTER IN FIGURE K

MOBILE: TO GENERATE CONTINUOUS TURN-OFF CODE REFER TO ENCODER DIAGRAM G765

SWITCH

Q810 TURNS ON AFTER BINARY CODE IS DECODED - ALSO ACTIVATES Q808

HIGH UNSQUELCHES RECEIVER AUDIO IF VALID CODE IS DECODED

ACTIVE FILTER AND AMPLIFIER

140 Hz 3 POLE LOW PASS FILTER

DATA CONDITIONER

DATA CONDITIONER OUTPUT

DATA CONDITIONER ERROR VOLTAGE

PRECISION CURRENT SOURCE

INVERTER / LEVEL SHIFTER

Q811, R830, R829 DELAYS Q809 TURN OFF FOR 1 SEC. FOR FADE MARGIN.

Q807 - Q808 SUPPLIES 150 μA CONSTANT CURRENT TO U802

ISOLATION SWITCH

CURRENT SOURCE DISABLE SWITCH

Q805 IS TURNED ON WHEN VALID CODE IS DECODED, DISABLING PRECISION CURRENT SOURCE AND DECREASING CURRENT TO U802-8 THRU R823, RESULTING IN INCREASED DECODING SENSITIVITY

U805 SWITCH ON AND OFF BY U802 7 OUTPUT. GATES CR08 CHARGING CURRENT THRU R823

TIMING CAPACITOR C808 CHARGE - DISCHARGE

INPUT BIASING AND TRANSIENT SUPPRESSOR CIRCUITRY

LEVEL SHIFTER

CR08 COLLECTOR WAVEFORM

U802 PROVIDES SQUARING OF INPUT DATA AND DESENSITIZATION OF LOW FREQUENCY NOISE COMPONENTS

U802 DATA CONDITIONER

AF FILTER RESPONSE TABLE	
FREQ IN Hz	DOWN FROM 1000 Hz REF
60 Hz	-47.2 DB
134 Hz	21.5 MV
250 Hz	10.2 MV

LEGEND
- = THEORY OF OPERATION DATA
- = MAINTENANCE DATA
- = PRIMARY SIGNAL FLOW
- = SECONDARY SIGNAL FLOW

EEPS-17045-D

DETAIL B
MOBILE INTERCONNECTIONS (NOTE 8)

AUDIO & SQUELCH BOARD: CONT. 9.6V; DECODER OUTPUT; DECODER INPUT

"DIGITAL PRIVATE-LINE" DECODER BOARD: CONT. 9.6V; CODE OUT; J803 SQUELCH ENABLE; DATA IN; J802 B+; J805 XMIT CODE ENABLE

CONTROL (INTERCONNECT) BOARD: P816-2 CODE OUT; P816-3 XMIT ENABLE; P816-1 B+

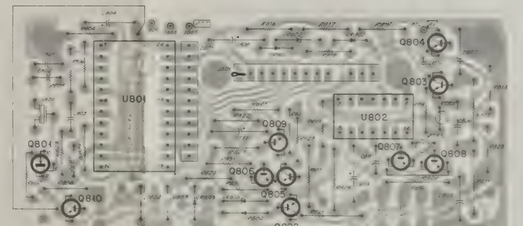
"DIGITAL PRIVATE-LINE" DECODER

MODEL TLN5729A

FUNCTION
1. Decodes A 23-bit binary code word to unsquelch the receiver.
2. In radios with simplex "Digital Private-Line" operation, generates a 23-bit binary code word when the transmitter is keyed.

TECHNICAL CHARACTERISTICS

CODE DETERMINING DEVICE	TRN6005A CODE PLUG
CODE FORMAT	23-BIT WORD
CODE FREQUENCY SPECTRUM	11-67 Hz
OUTPUT	SWITCHED 5.3 V DC



SHOWN FROM COMPONENT SIDE

"DIGITAL PRIVATE-LINE" DECODER

"DIGITAL PRIVATE-LINE" DECODER BOARD TROUBLESHOOTING CHART

NOTES:

1. To obtain a test code for the following procedure apply a carrier frequency signal to the receiver rf input from an rf signal generator modulated by the code output of a Motorola SLN6413A "Digital Private-Line" Test Set. Be sure the signal generator is able to accept very low frequency modulation (less than ±5 Hz).
2. Before you replace U801, use the following procedure to verify that U801 is malfunctioning:
   a. Connect U801-11 to the code input of a Motorola SLN6413A "Digital Private-Line" Test Set.
   b. Apply a carrier-frequency signal to the receiver rf input from a signal generator that is modulated by the code output of the test set.

   If proper decode is indicated, U801 must be replaced. If U801 must be replaced, refer to the CMOS handling precautions.

SYMPTOM	PROBABLE CAUSE	ACTION
No decode, but received audio is good when PL is disabled.	1. Audio squelch is malfunctioning.	Remove the decoder board. Apply +9.6 V at P201-3 on audio & squelch board. If audio is not enabled, troubleshoot audio & squelch circuits.
	2. No 50 kHz clock	Check U801-4 for 50 kHz clock pulses. Rise time must be ≤750 n sec.
	3. Audio enable switch is malfunctioning.	If U801-7 is high, but circuit board pin 5 is low when receiving code, replace Q810.
	4. Dump pin U801-1 is always high.	Check U801-1 should always be 0 V.
	5. Wrong or bad code plug.	Replace with a known good code plug. Check U801-15 through U801-23 for proper octal code.
	6. No data into U801.	Check U801-11 for 0 - 6 V pulses. If pulses are not present, check Q806 and U802 operation.
	7. Transmit code enable input is high.	Ground U801-9. If a received code is properly decoded, check for a malfunction in the delayed transmit enable circuit on the encoder board.
	8. U801 has an internal malfunction.	If, after checking causes 1 through 7, the cause of the problem has not been isolated, replace U801. CAUTION U801 is a CMOS device and may be damaged by improper handling. Refer to the CMOS handling precautions in this instruction section.
Excessive decoder falsing when monitoring an inactive channel (noise falsing).	1. Precision current source is low or inoperative.	Measure the dc voltages in the precision current source circuits. Current to U801-8 = (V_{BE} of Q808) (R825 + R826 +RT802)/ R826 (R825 + RT802)
	2. Current source disable switch is always on.	Check for 8 - 10 V at Q809 collector. If Q809 collector is 0 V, replace Q809.
	3. Improper 140 Hz low pass filter response.	Check dc voltages in filter circuit. Check the filter frequency response. Measured at Q803 emitter, the filter response should be -1.0 to -4.0 dB at 134 Hz and -12 to -15 dB at 250 Hz with 50 mV rms signal at decoder input.
	4. U802 supply voltage is too high.	Check U802-10 for +10.4 V ±0.2 V dc. If voltage is high, troubleshoot the +10.4 V regulator on the decoder board.
Excessive squelch tails (approx. 500 msec noise burst) at ends of received transmissions	1. Turn-off code not being transmitted by other radio unit.	Monitor circuit board pin 4 (DATA IN) for presence of turn-off code at ends of transmissions.
	2. U802 lock-in malfunction	Ground Q809 collector. With a 300 mV p-p signal at circuit board pin 4 (DATA IN), the waveform at U802-4 should be locked in to the input signal up to at least 175 Hz. If proper lock-in does not occur, replace C809, then check lock-in again. If lock-in is still bad, replace U802.
	3. U801 turn-off code detector is malfunctioning.	Check U801 (Note 2).
Poor detector sensitivity in poor quieting conditions	1. Improper 140 Hz low pass filter response response.	Check dc voltages in filter circuit. Check the filter frequency response: measured at Q803 emitter, the filter response should be -1.0 to -4.0 dB at 134 Hz and -12 to -15 dB at 250 Hz with 50 mV rms signal at decoder input.
	2. Precision current source supplying too much current to U802-8.	Measure the dc voltages in the current source circuits. Current to U802-8 = (V_{BE} of Q808) (R825 + R826 + RT802) R826 (R825 + RT802)
	3. Current source disable switch inoperative.	While detecting a valid code, check Q809 collector for 0 V dc. If 8-10 V is present, replace Q809.
Occassional squelch tail about 1 second after the end of a transmission from another radio	Current source disable switch is staying on too long.	Check Q809 collector. Q809 collector should go from 0 V dc to 8-10 V within 1.5 seconds after loss of audio squelch disable.